Wind: The Big Picture

Steve Gaw

Wind Coalition Members

- AES Wind Generation | Acciona | Apex Wind Energy | Blattner Energy, Inc. | BP Alternative Energy North America | Clean Line Energy | Duke Energy | Edison Mission Energy | EDP | ENEL | EDF | E.ON | Exelon | Electric Power Engineers, Inc | Gamesa Energy | GE Energy | Iberdrola Renewables | Infinity Wind | Invenergy | Nobel Environmental Power | Pattern | RES Americas | Stahl, Bernal & Davies | Third Planet | TradeWind Energy, LLC | Vestas-Americas, Inc.
- **Non-Profit Members:** AWEA | Environmental Defense Fund | Public Citizen | TREIA

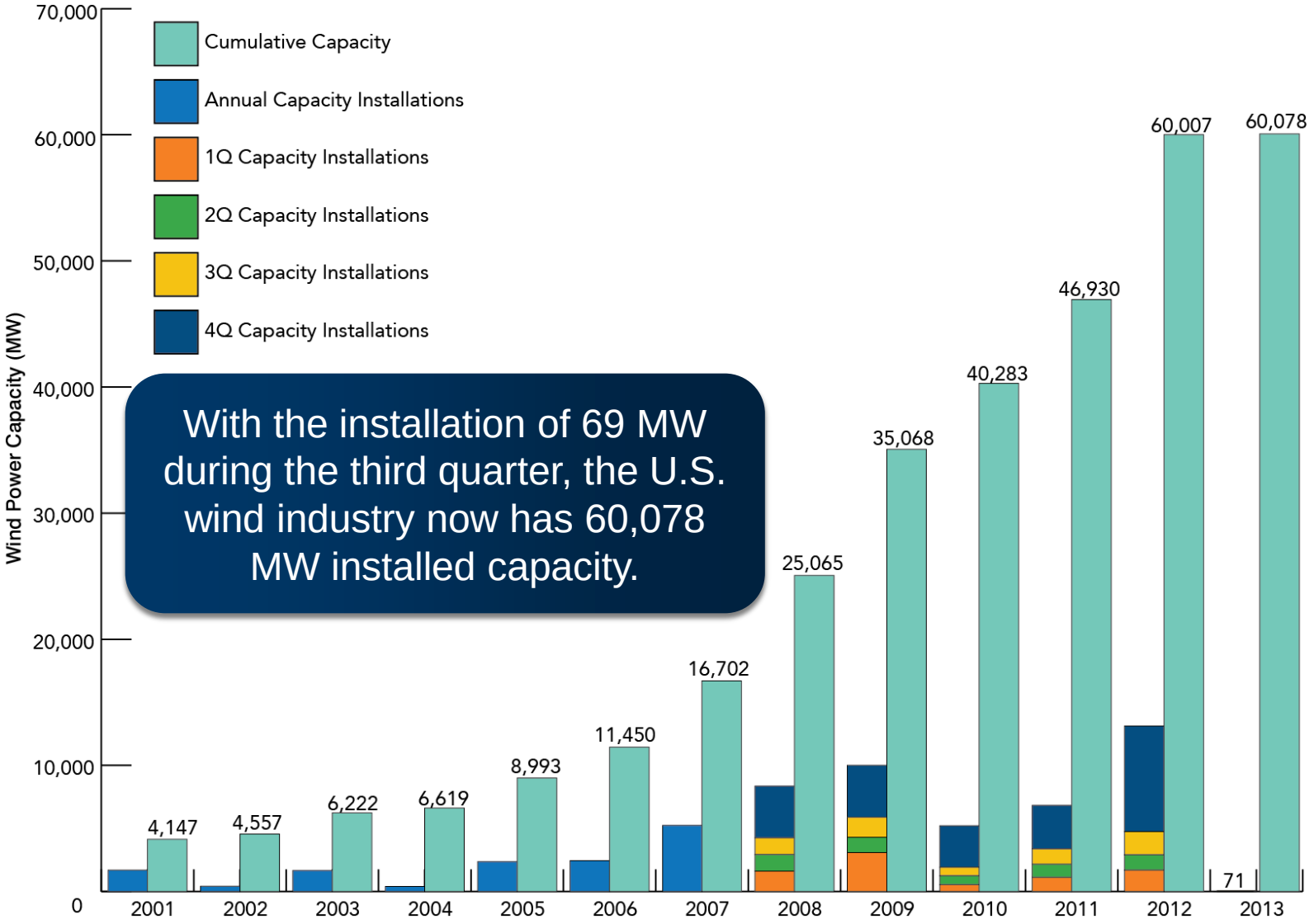
Why Wind?

- **Hedge:** Wind energy contracts can be used as a **long-term hedge** against volatility in fossil fuel prices and environmental regulations.
- **Price:** Wind energy is providing **prices that are competitive** with other new generation options, and has been shown to reduce prices to consumers.
- **Security:** Enhancing energy security by diversifying the electric generation portfolio.
- **Economic Development**: Billions have been invested as a result of wind development.
- **Environment**: Wind is a zero polluting and non-carbon emitting energy resource that uses no water to produce power.

What does wind power mean for America's energy future?

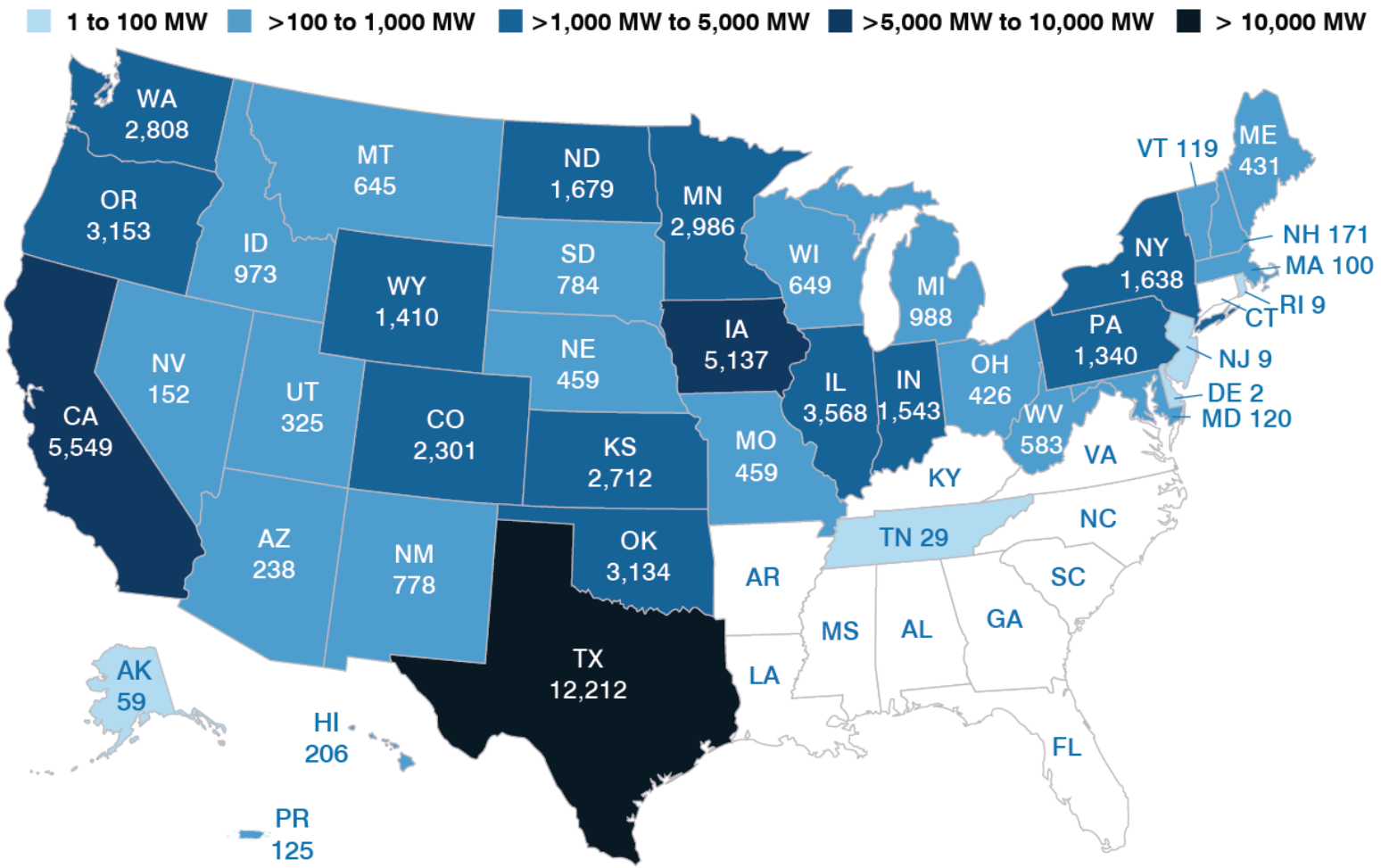
- ✓ Wind power was #1 in new capacity installed in 2012
- ✓ 13,124 MW of wind capacity installed during 2012
- ✓ 60,000 MW milestone reached for cumulative installed wind capacity
- ✓ 2012 was largest year in U.S. history, and largest fourth quarter
- ✓ 45,100 turbines installed across 39 states & Puerto Rico

Installed U.S. Wind Energy Capacity

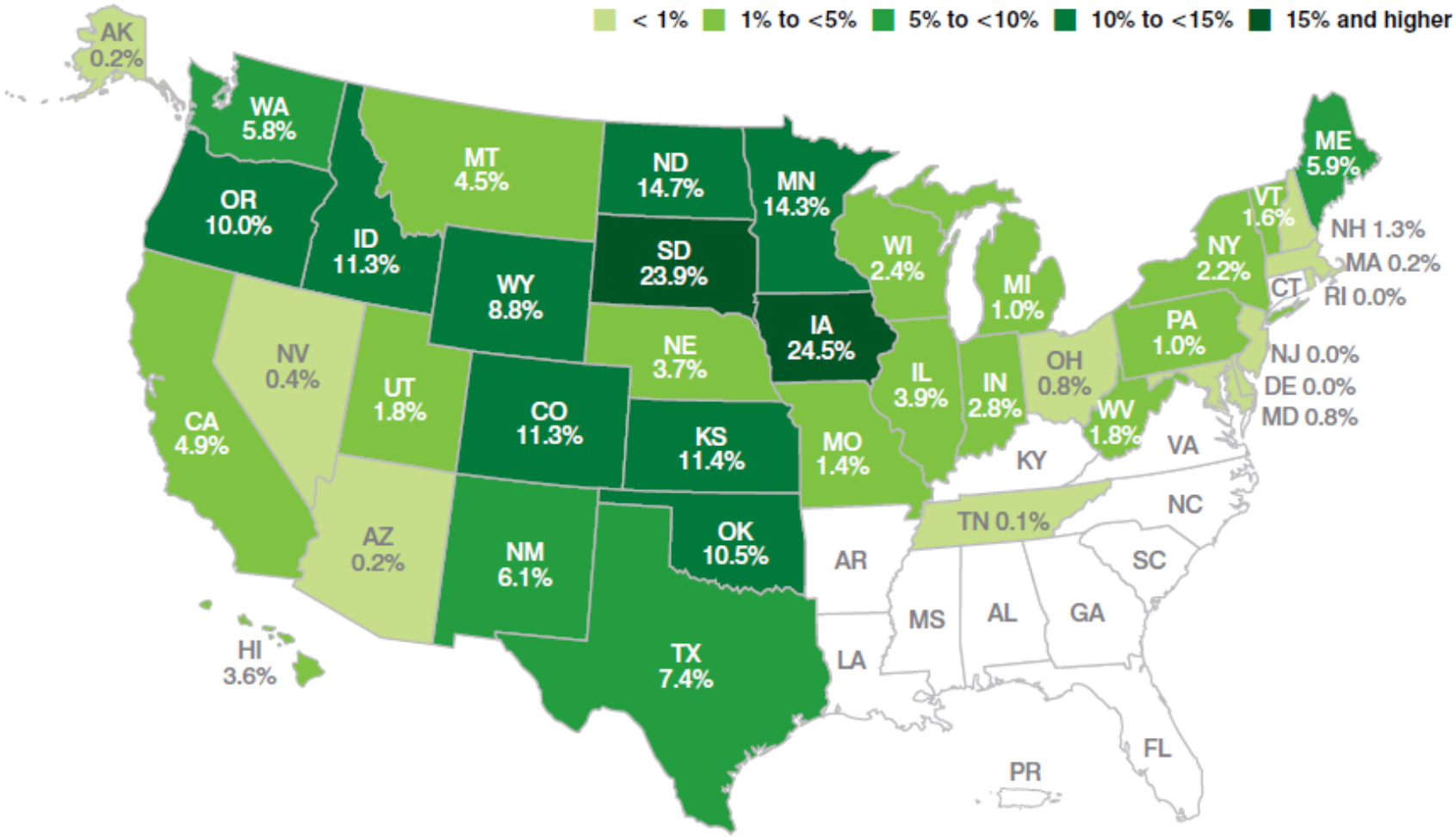


Source: AWEA U.S. Wind Industry Third Quarter 2013 Market Report

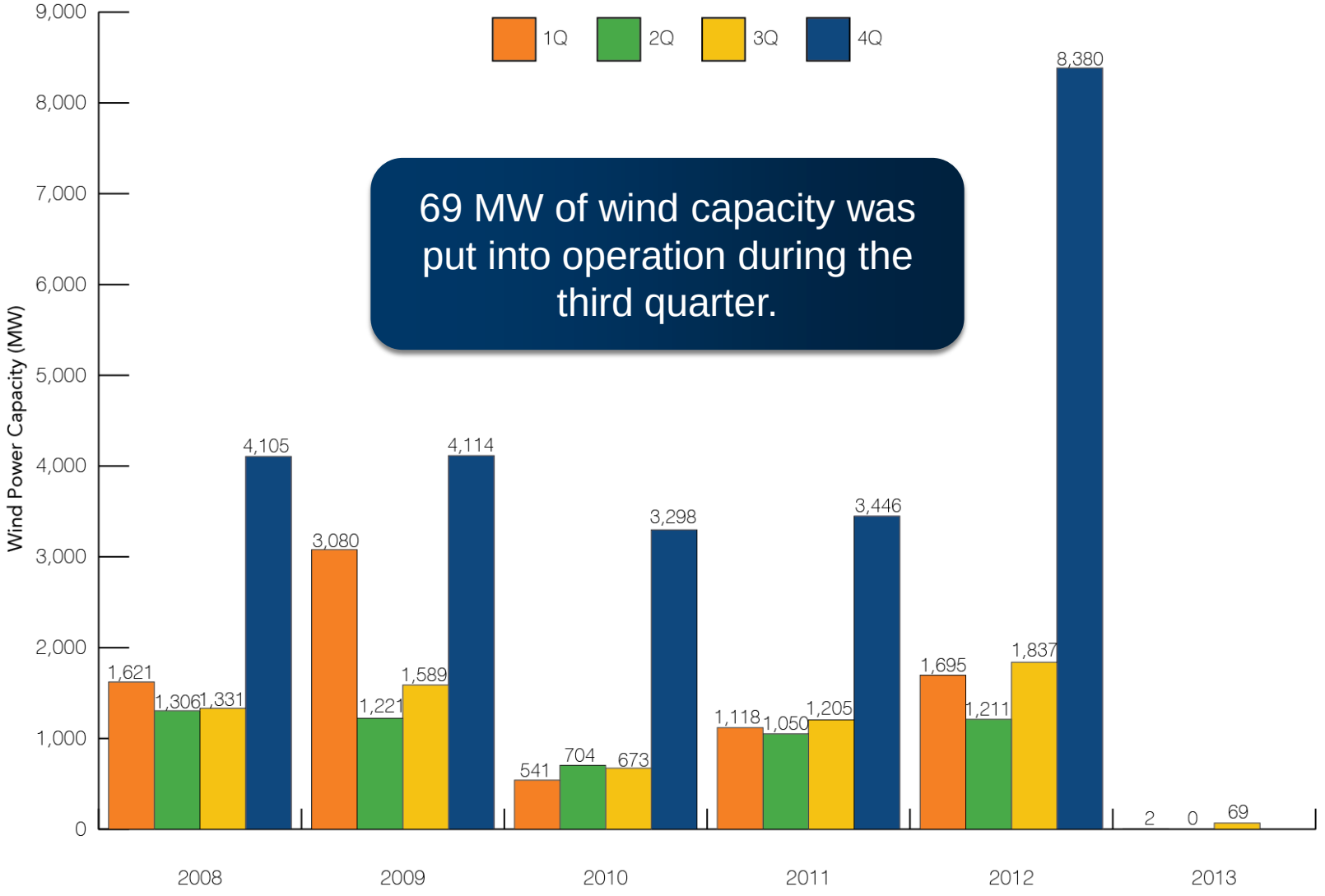
U.S. Wind Power Capacity Installations by State



9 states have **10% or more** of their electricity supplied by wind power

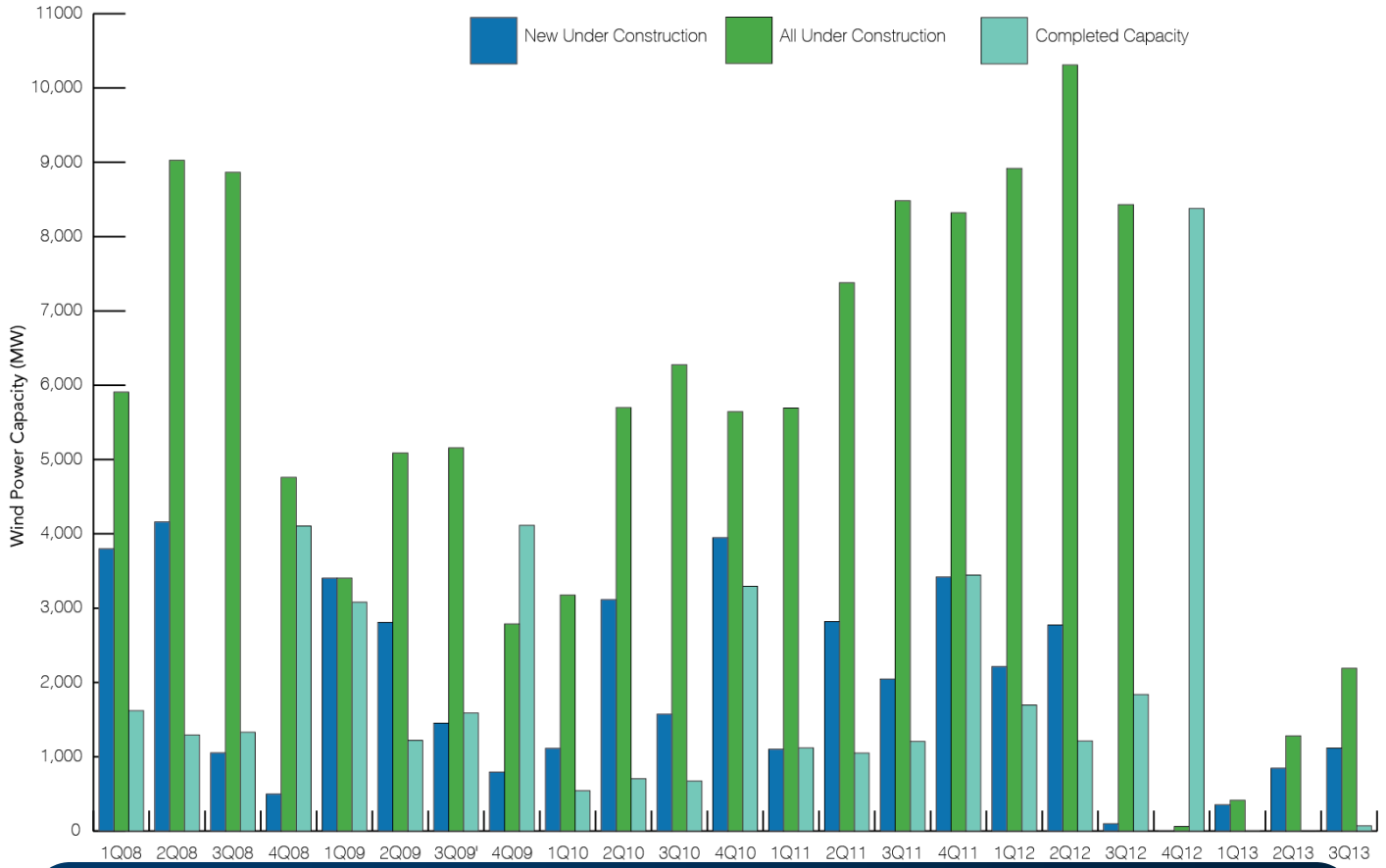


Installations by Quarter



Source: AWEA U.S. Wind Industry Third Quarter 2013 Market Report

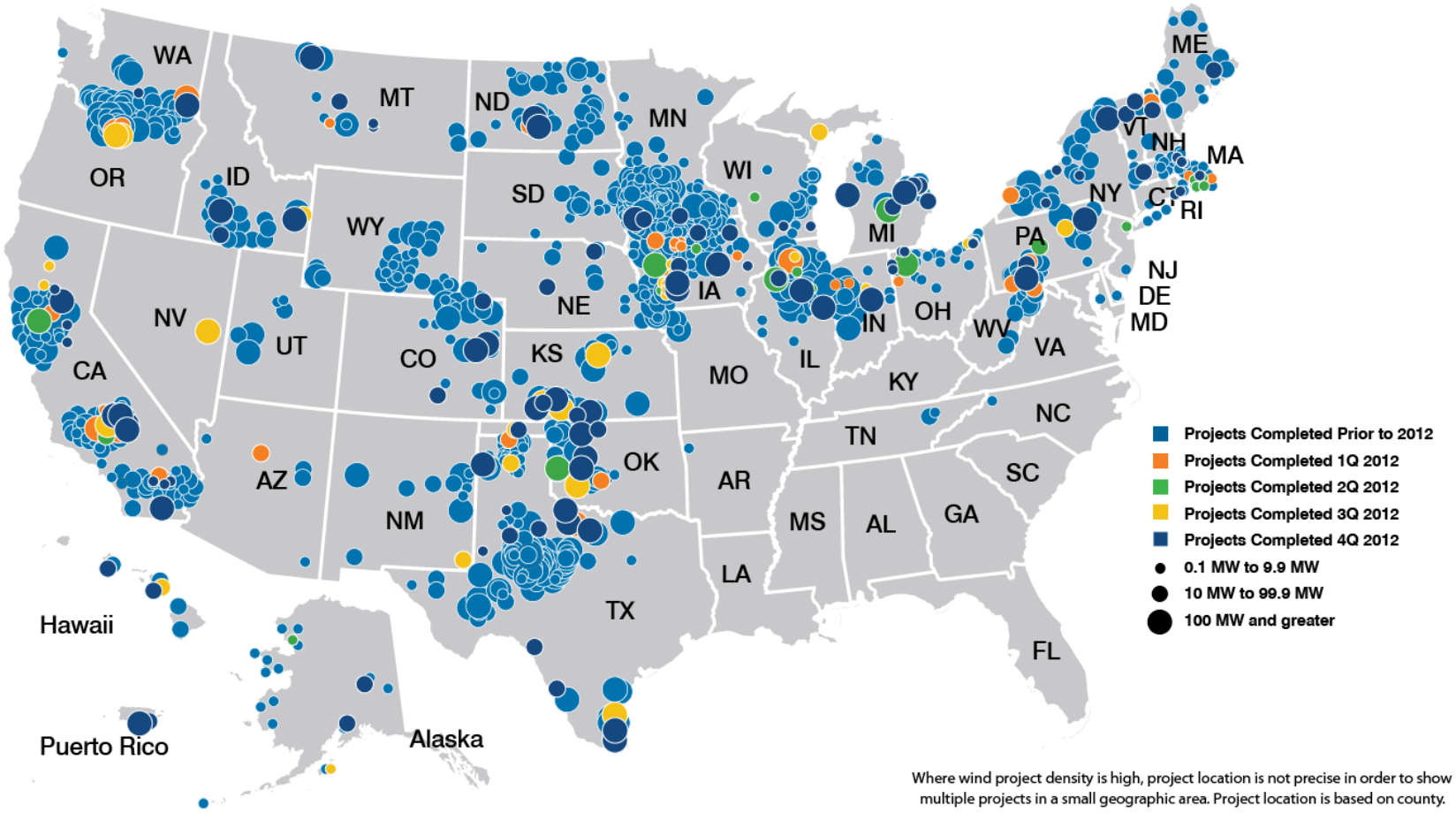
Quarterly Construction Activity



Through 3Q, over 2,300 MW of wind projects under construction across 13 states, with 1,100 MW of new construction starts during 3Q.

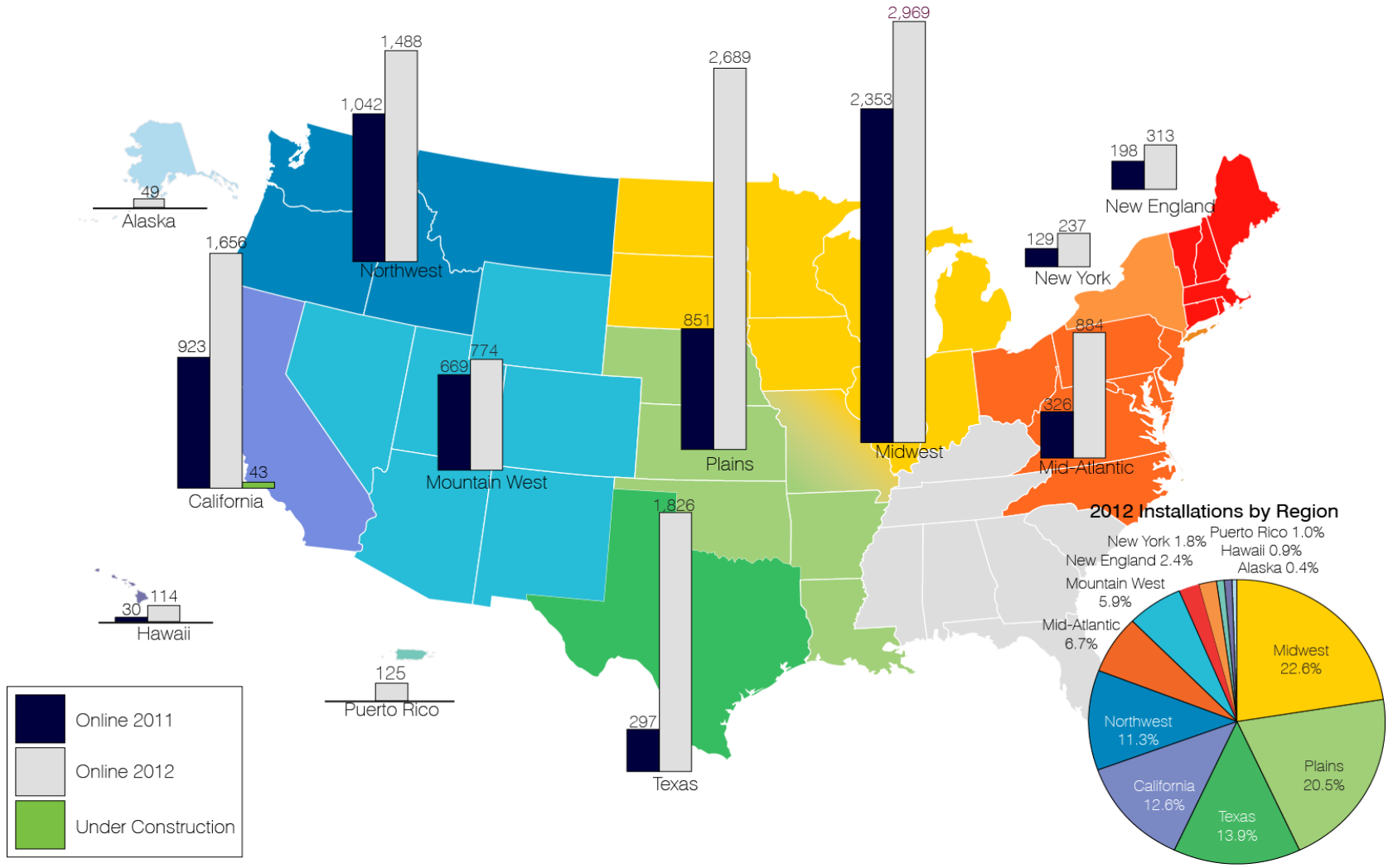
Source: AWEA U.S. Wind Industry Third Quarter 2013 Market Report

U.S. Wind Project Map

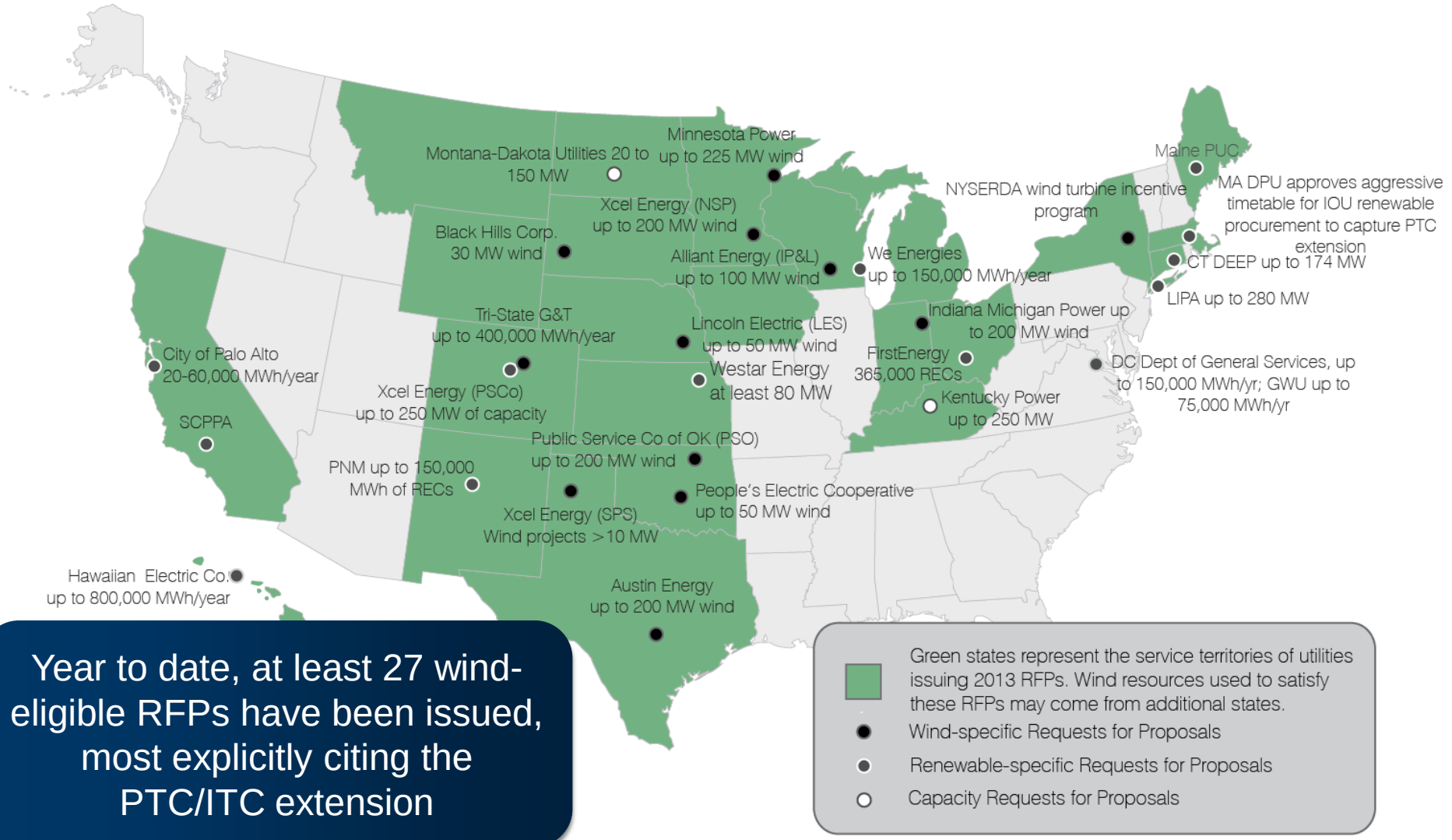


Where wind project density is high, project location is not precise in order to show multiple projects in a small geographic area. Project location is based on county.

Regional Installation Trends



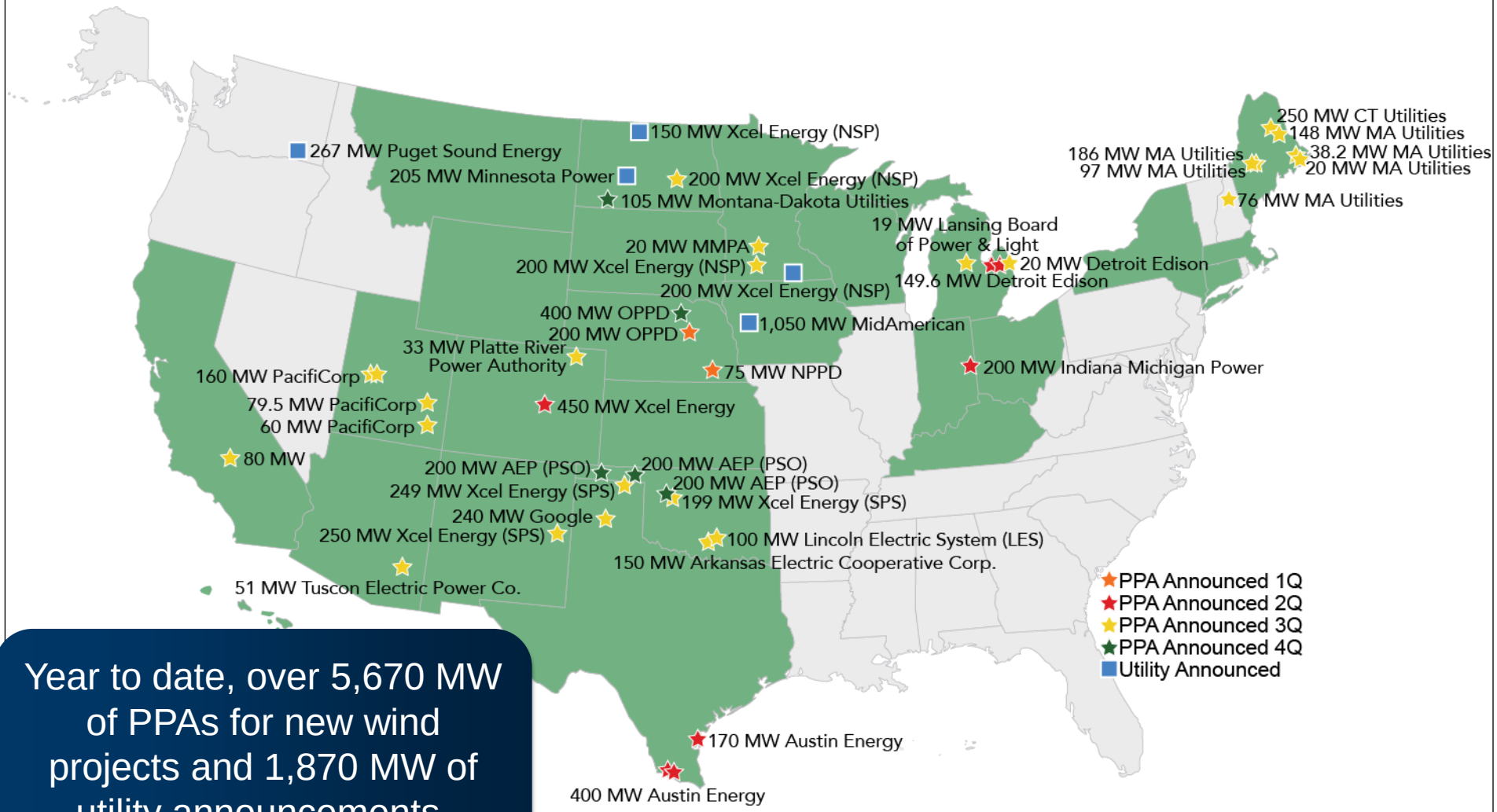
AWEA Market Update: 2013 RFPs



Year to date, at least 27 wind-eligible RFPs have been issued, most explicitly citing the PTC/ITC extension

Source: AWEA U.S. Wind Industry Third Quarter 2013 Market Report

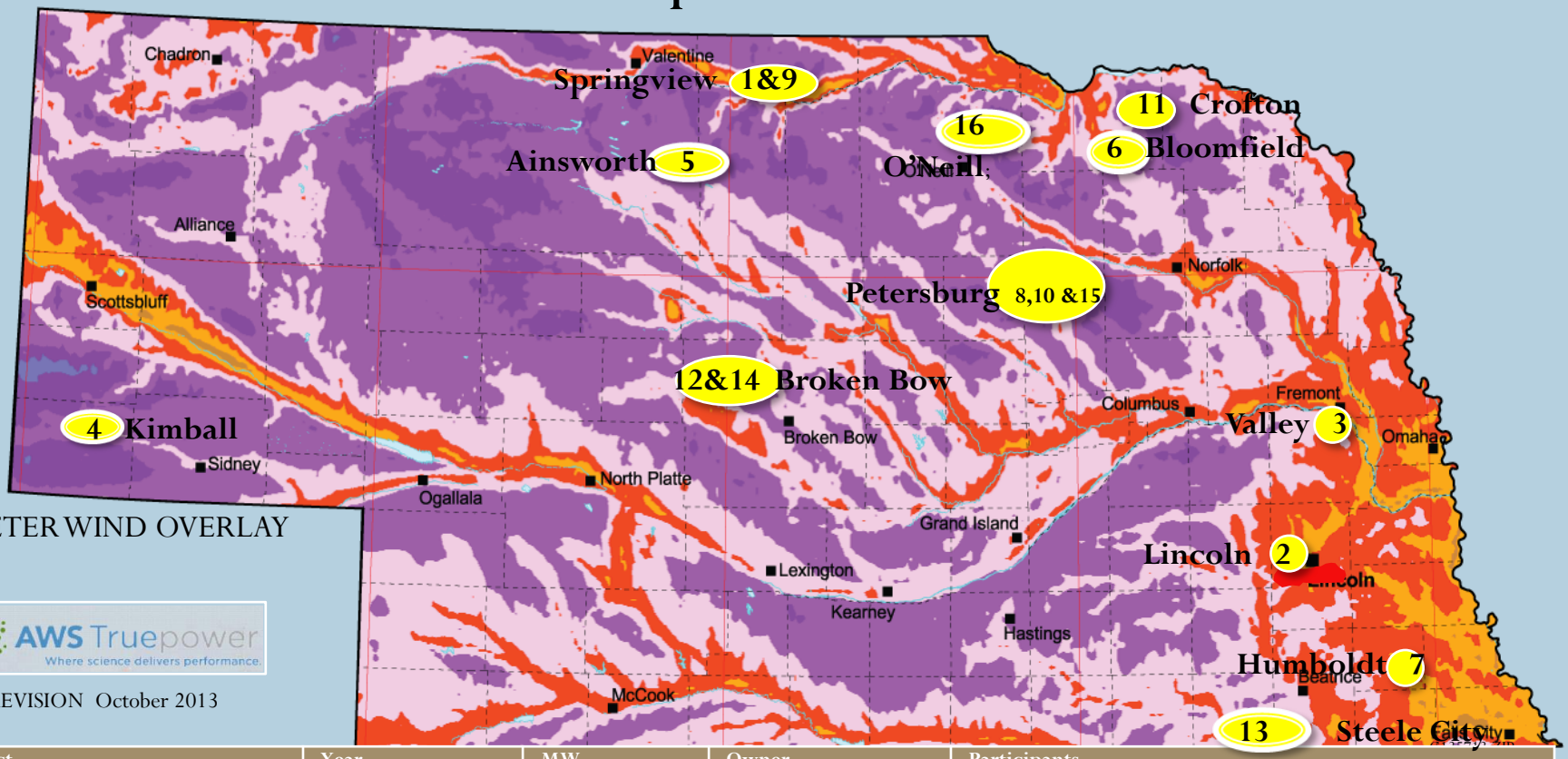
AWEA Market Update: 2013 PPAs



Year to date, over 5,670 MW of PPAs for new wind projects and 1,870 MW of utility announcements.

Source: AWEA U.S. Wind Industry Third Quarter 2013 Market Report

Wind Development in Nebraska



80 METER WIND OVERLAY

AWS Truepower
Where science delivers performance.

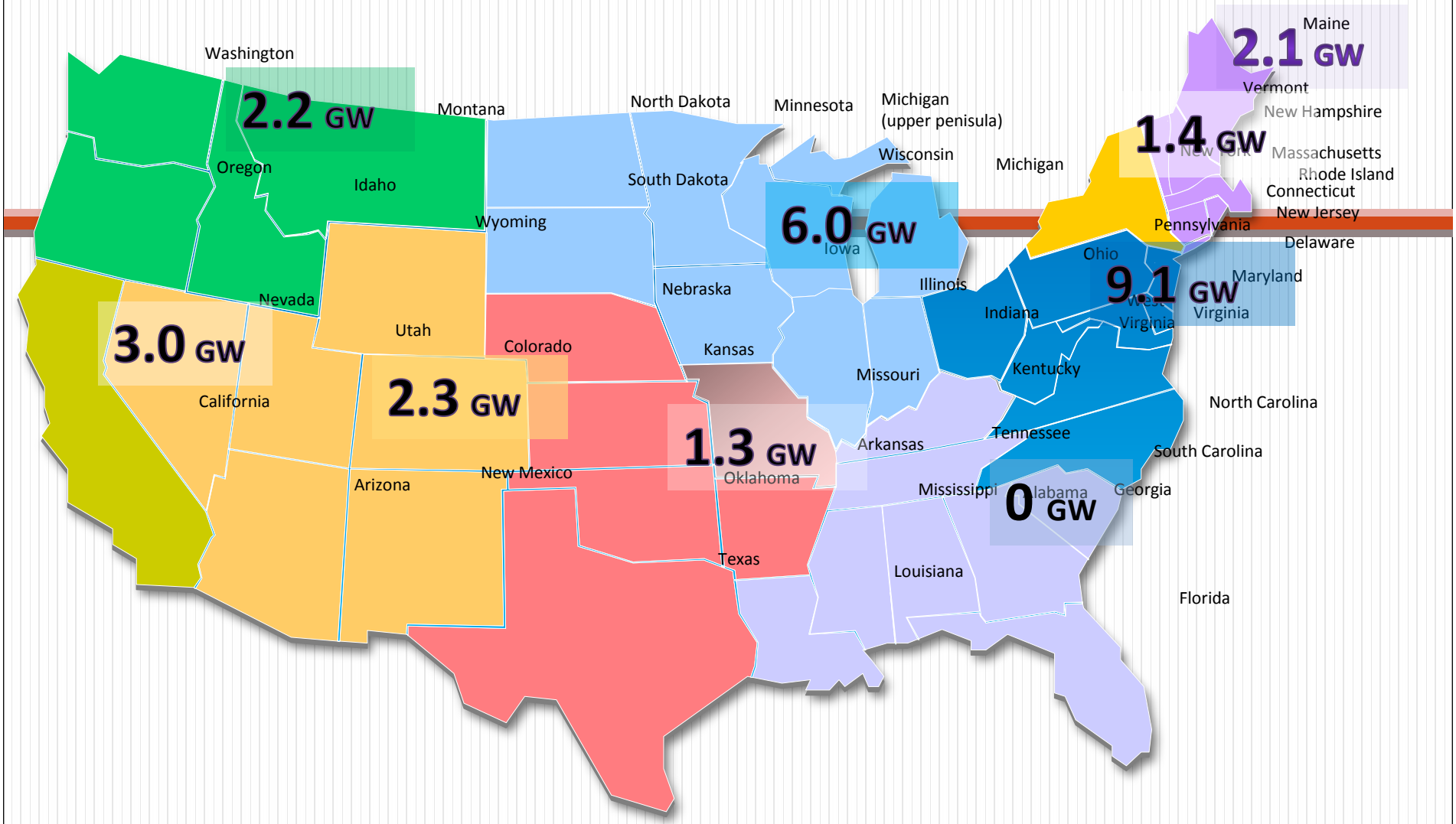
REVISION October 2013

Project	Year	MW	Owner	Participants
1) Springview Wind Energy	1998	Retired	NPPD	NPPD, LES MEAN, GI, KBR, Auburn
2) Salt Valley	1998 and 1999	1.32	LES	LES
3) Valley	2001	.66	OPPD	OPPD, Valmont
4) Kimball	2002	10.5	MEAN	MEAN
5) Ainsworth Wind Energy	2005	59.4	NPPD	NPPD, OPPD, MEAN, GI, JEA* **Financial Participant for RECs*
6) Elkhorn Ridge Wind, LLC	2009	80	Edison Mission	NPPD, OPPD, MEAN, LES, GI
7) Flat Water Wind Farm, LLC	2010	60	Gestamp Wind N.A.	OPPD
8) Laredo Ridge Wind Farm	2011	80	Edison Mission	NPPD, LES, MEAN, GI
9) Springview II/Bluestem, LLC	2011	3	Bluestem, LLC	NPPD, OPPD**, LES**, GI**, ***will receive direct drive knowledge and RECs*
10) TPW Petersburg, LLC	2011	40.5	Gestamp Wind N.A.	OPPD
11) Crofton Bluffs Wind Farm	2012	42	Edison Mission	NPPD, OPPD, LES, MEAN
12) Broken Bow Wind, LLC	2012	80	Edison Mission	NPPD, OPPD, LES, GI
13) Steele Flats Wind	2013	74.8	NextEra	NPPD
14) Broken Bow II	2014	75	Edison Mission	NPPD, OPPD
15) Prairie Breeze	2014	200	Invenergy	OPPD
16) Grande Prairie	2015	400	Geronimo	OPPD
		~1207 Total MW		

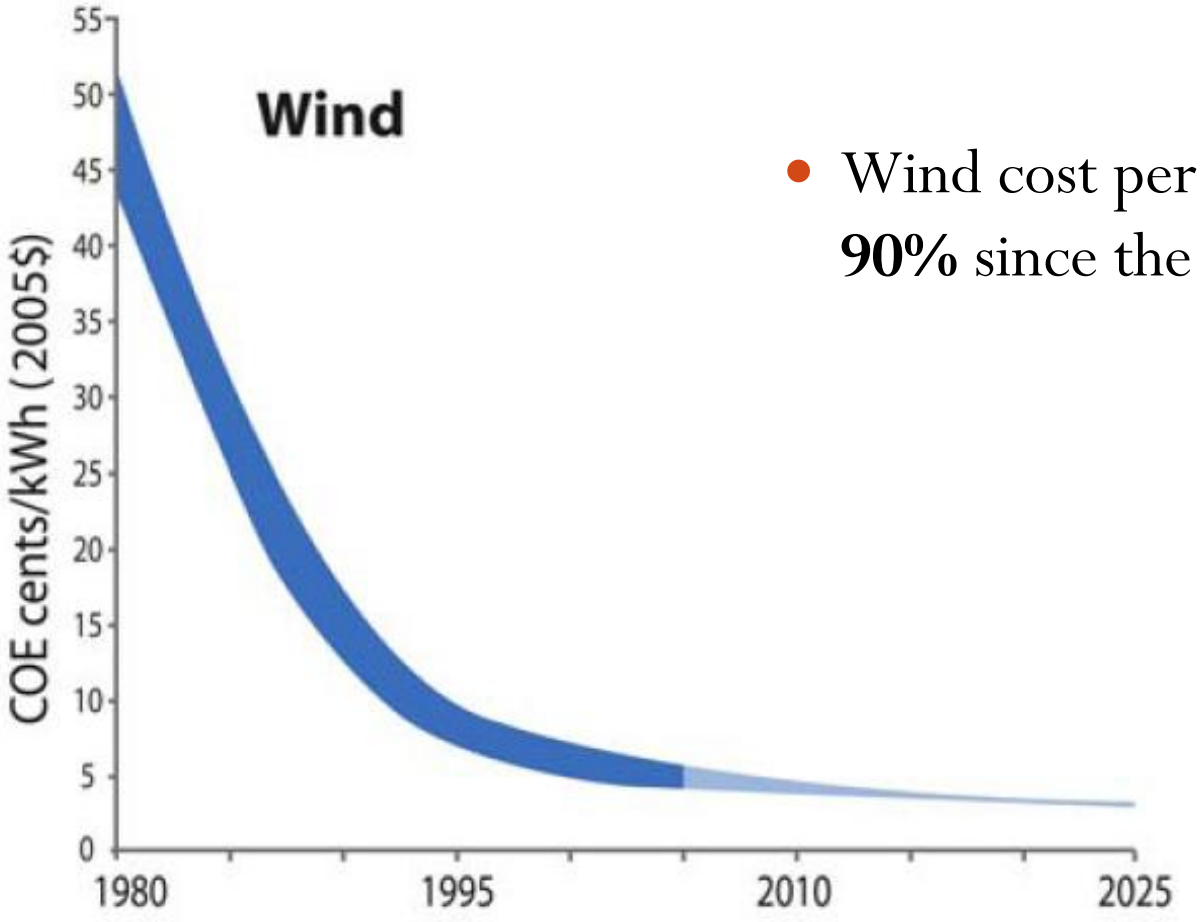
SPP Wind Generation's Increasing Importance in Supplying Electricity

- As of May 30, 2011, there were over 4,000 MW of wind generation in operation within the SPP region. This is an increase from 3,300 MW indicated in the 2010 report.
- Today SPP has over 8000 MW of installed wind Generation
- "Because of growing output from wind generators, the value and use of electric baseload capacity is declining in the Southwest Power Pool (SPP)." EIA release September 2013

Regional Expected Wind RPS Demand

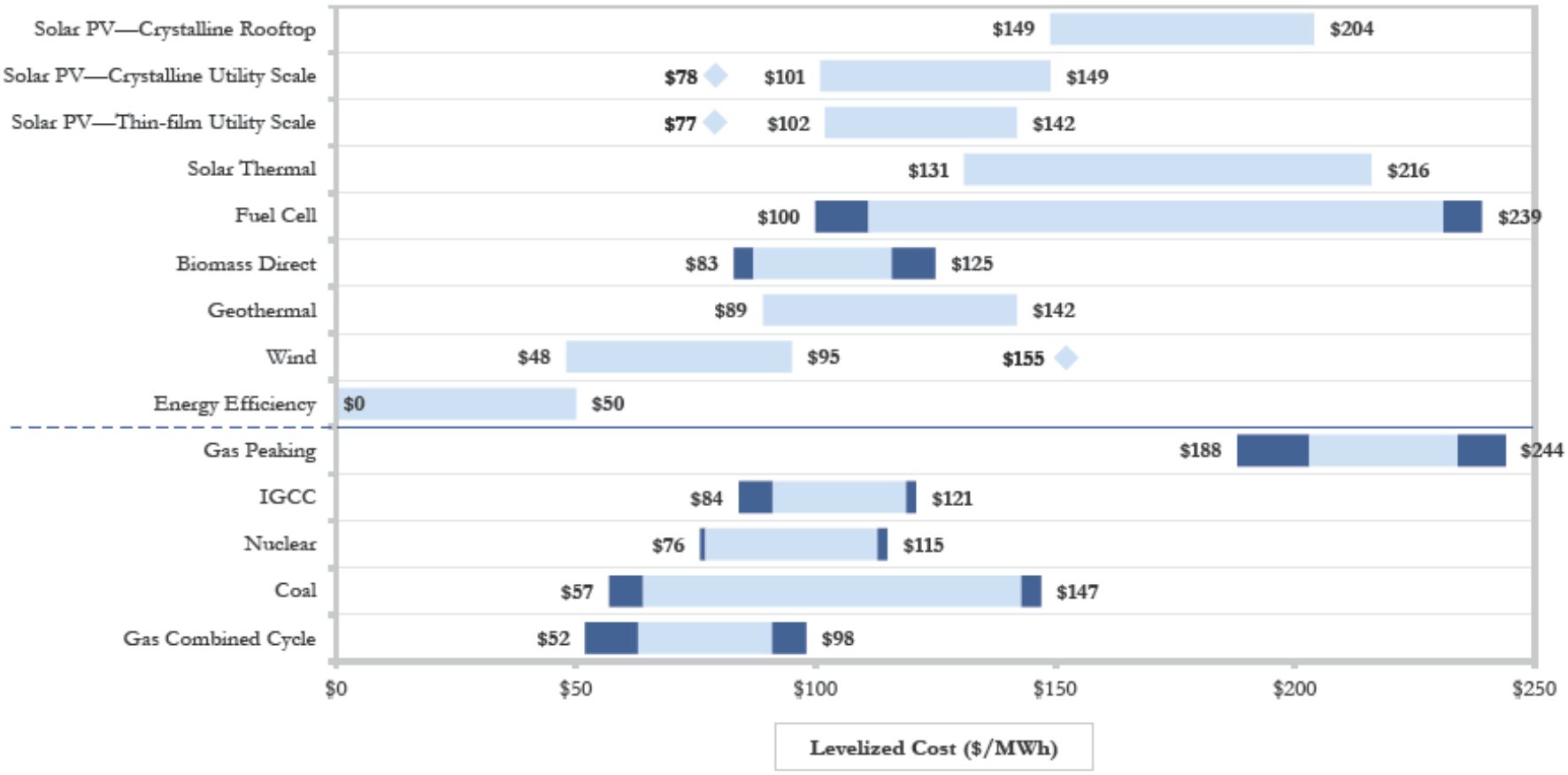


Historical Cost of Wind Energy

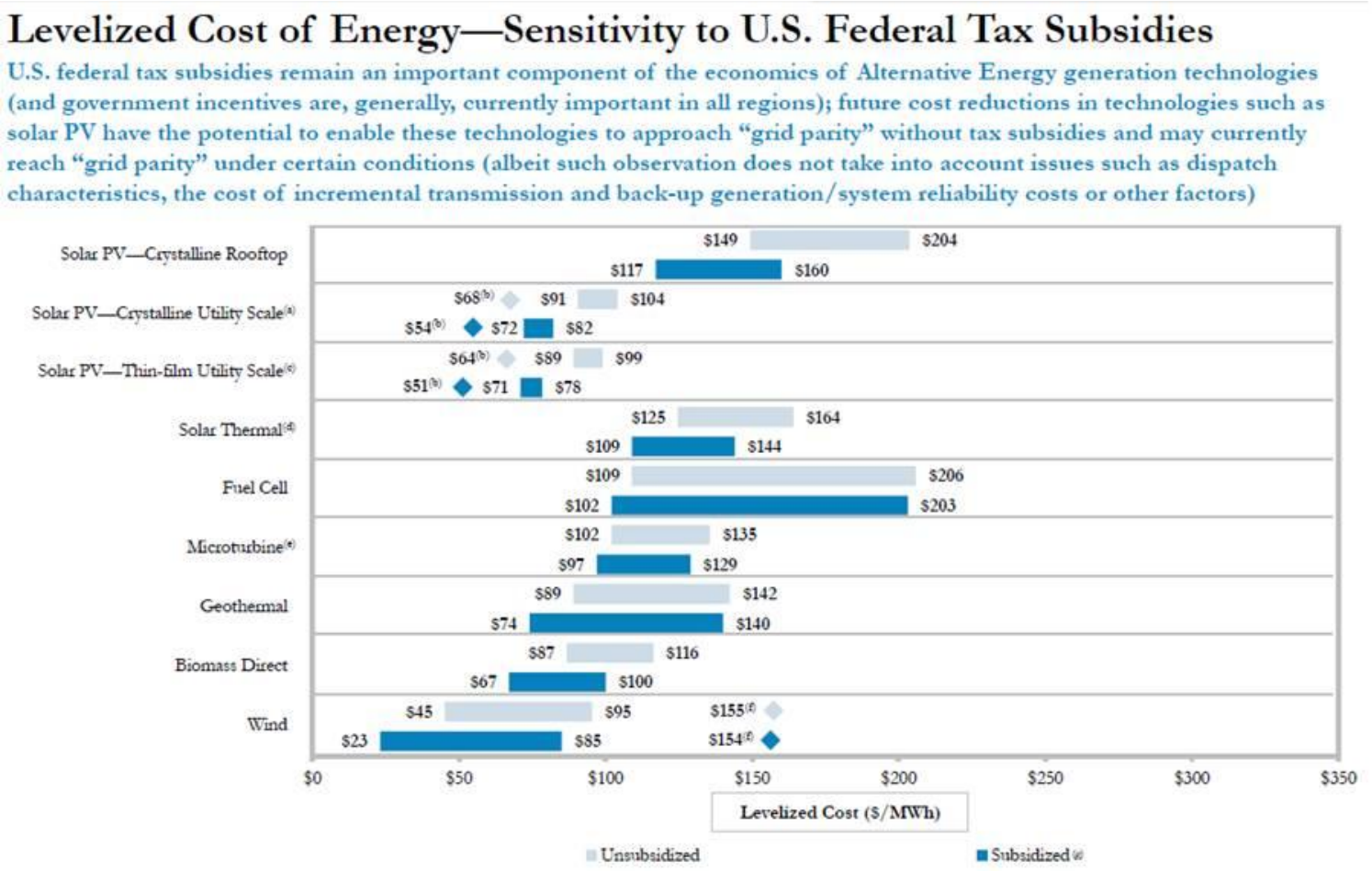


- Wind cost per kwhr has **declined 90%** since the early 1980's

Wind Energy Is Cost Competitive With New Generation

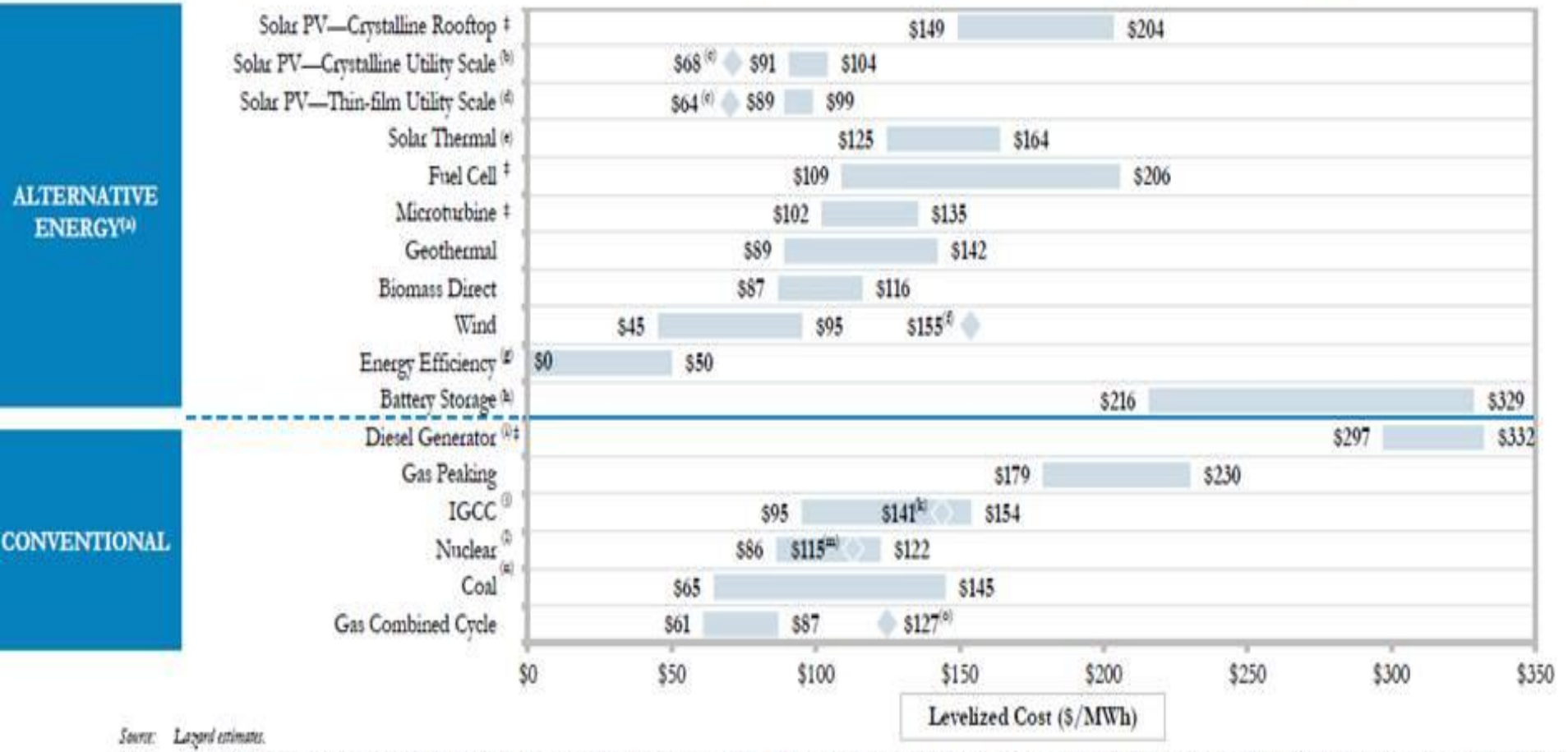


Wind Prices


Levelized Cost of Energy—Sensitivity to U.S. Federal Tax Subsidies
U.S. federal tax subsidies remain an important component of the economics of Alternative Energy generation technologies (and government incentives are, generally, currently important in all regions); future cost reductions in technologies such as solar PV have the potential to enable these technologies to approach "grid parity" without tax subsidies and may currently reach "grid parity" under certain conditions (albeit such observation does not take into account issues such as dispatch characteristics, the cost of incremental transmission and back-up generation/system reliability costs or other factors)
Solar PV—Crystalline Rooftop
$149
$204
$117
$160
Solar PV—Crystalline Utility Scale(a)
$68(b)
$91
$104
$54(b)
$72
$82
Solar PV—Thin-film Utility Scale(c)
$64(b)
$89
$99
$51(b)
$71
$78
Solar Thermal(d)
$125
$164
$109
$144
Fuel Cell
$109
$206
$102
$203
Microturbine(e)
$102
$135
$97
$129
Geothermal
$89
$142
$74
$140
Biomass Direct
$87
$116
$67
$100
Wind
$45
$95
$155(f)
$23
$85
$154(f)
$0
$50
$100
$150
$200
$250
$300
$350
Levelized Cost ($/MWh)
Unsubsidized
Subsidized(g)

Unsubsidized Levelized Cost of Energy Comparison

Certain Alternative Energy generation technologies are cost-competitive with conventional generation technologies under some scenarios, before factoring in environmental and other externalities (e.g., RECs, transmission and back-up generation/system reliability costs) as well as construction and fuel cost dynamics affecting conventional generation technologies



Source: *Lazard estimates.*

Note: Assumes 60% debt at 8% interest rate and 40% equity at 12% cost for conventional and Alternative Energy generation technologies. Assumes Powder River Basin coal price of $1.99 per MMBtu and natural gas price of $4.50 per MMBtu. As many have argued, current solar pricing trends may be making material differences between the inherent economics of certain types of thin-film technologies and crystalline silicon.

‡ Denotes distributed generation technology.

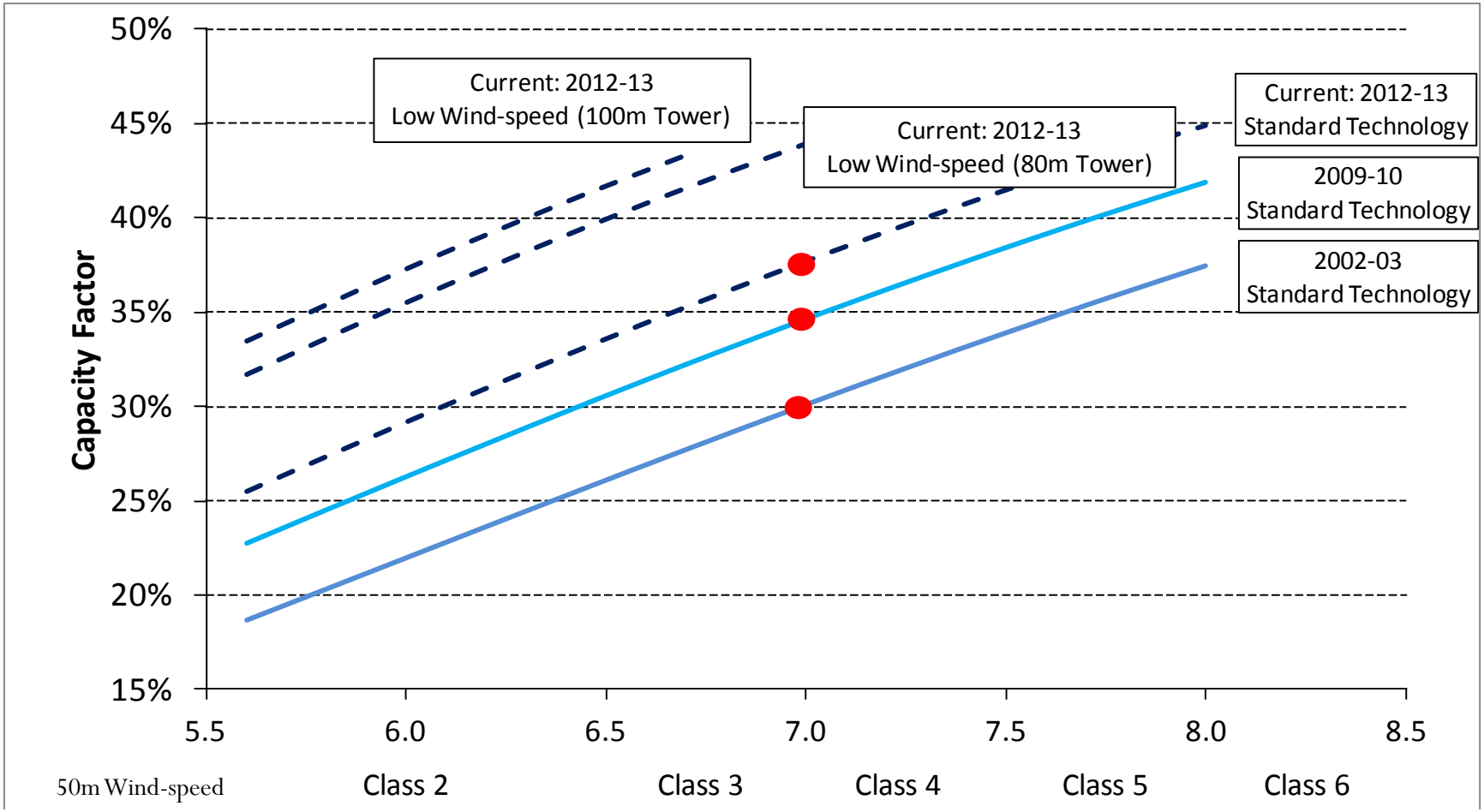
(a) Analysis excludes integration costs for intermittent technologies. A variety of studies suggest integration costs ranging from $2.00 to $10.00 per MWh.

(b) Low end represents single-axis tracking. High end represents fixed-tilt installation. Assumes 10 MW system in high insolation jurisdiction (e.g., Southwest U.S.). Not directly comparable for baseload.

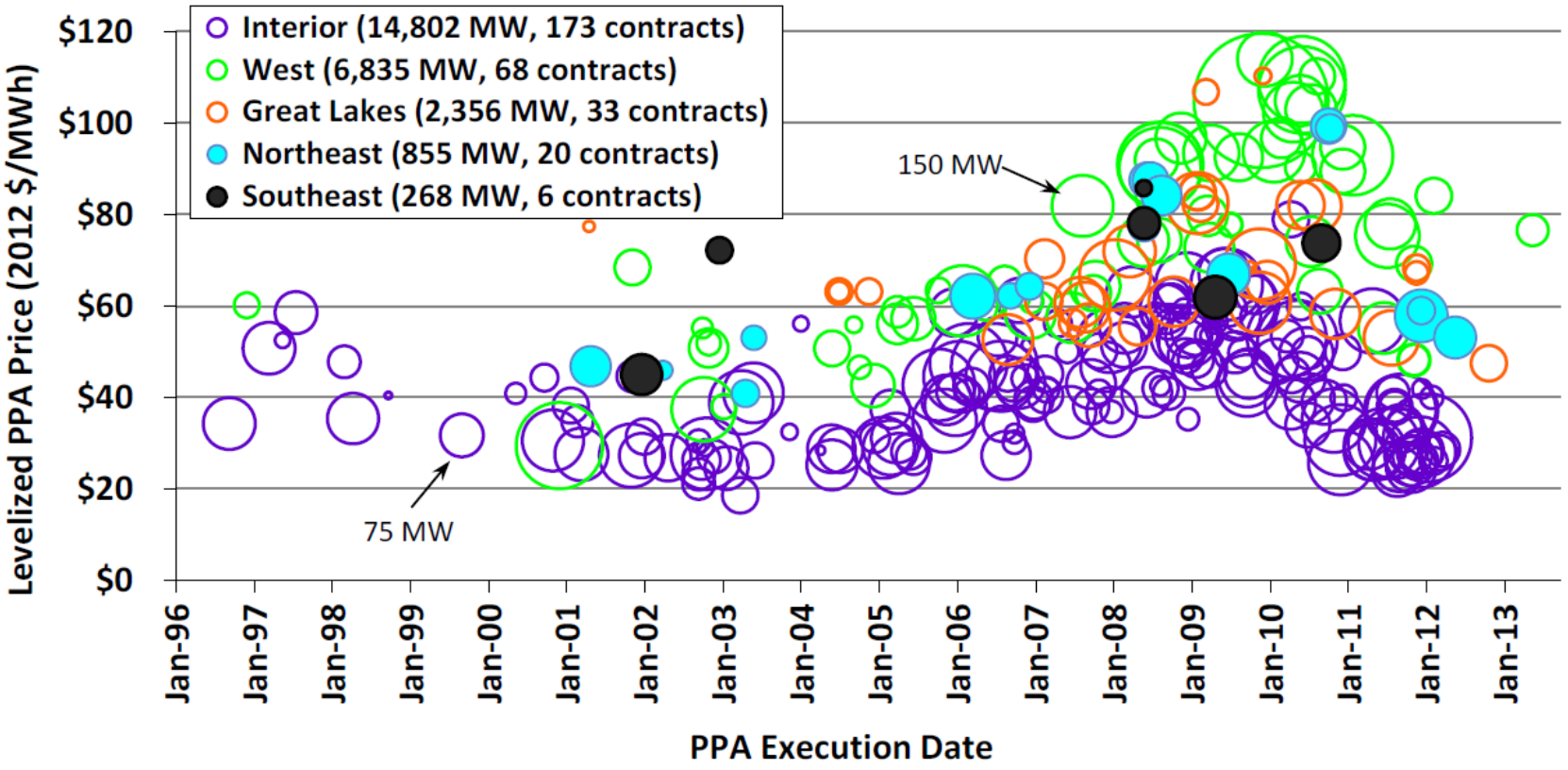
(c) Diamonds represent estimated implied levelized cost of energy in 2015, assuming $1.50 per watt for a crystalline single-axis tracking system and $1.50 per watt for a thin-film single-axis tracking system.

(d) Low end represents single-axis tracking. High end represents fixed-tilt installation. Assumes 10 MW fixed-tilt installation in high insolation jurisdiction (e.g., Southwest U.S.).

Cost Competitiveness: Technology Improvement & Capacity Factors

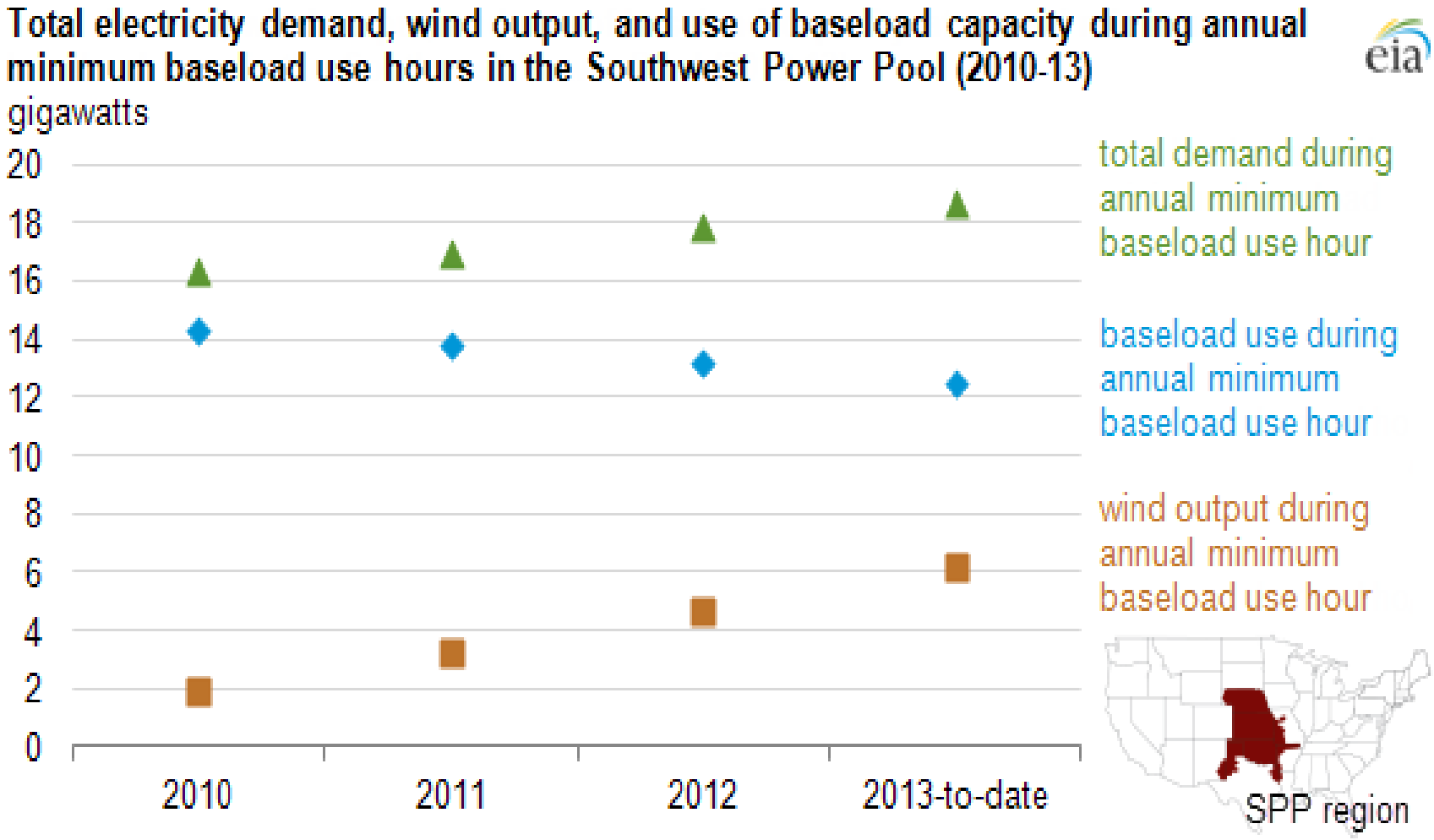


New Technology Is Reducing the Cost of Wind Energy



Source: DOE Wind Technologies Market Report 2012

Increasingly offsetting the use of baseload generation



Utilities on Wind

✓ **Midwest**

"We've found a way to meet the state of Minnesota's renewable energy standard early and reduce costs at the same time ... Expanding Bison will add to our renewable energy supply, resulting in the lowest cost resource over time by capturing the benefits of the extended production tax credit and a competitive turbine market"

- Al Hodnik, chairman and CEO of ALLETE after announcing the expansion of their Bison Wind Energy Center

✓ **Interior West**

"It works out to a very good levelized cost for our customers,…These prices are so compelling, the energy [cost] associated with it is less than you can do locking in a 20-year gas strip."

- Xcel Energy, Ben Fowke, Xcel President and CEO. The Colorado and Minnesota public utility commissions approved wind PPAs totaling 850 MW. Xcel Energy expects to pay about $25/MWh to $35/MWh over 20 years for the recently approved wind power purchase agreements

✓ **Northeast**

"By pooling the resources of all the utilities, we were able to purchase a large amount of clean, renewable energy for the state at below-market prices. In addition to delivering benefits for years to come, these agreements have the potential to save customers money over the long term."

- Ronald Gerwatowski, National Grid Sr. VP for U.S. Regulation and Pricing. The The state's biggest utilities, National Grid, Northeast Utilities, and Unitil Corp, in a milestone for New England's wind power industry, have signed long-term contracts for 565 MW of wind. If approved, the contracts would eventually save customers between 75 cents and $1 a month, utilities estimated.

✓ **Plains**

"The decision to contract for an additional 400 MW was based on extraordinary pricing opportunities that will lower costs for PSO's customers by an estimated $53 million in the first year of the contracts. Annual savings are expected to grow each year over the lives of the contracts."

- American Electric Power's Public Service Company of Oklahoma, signed power purchase agreements for 400 MW of wind energy capacity, noting it decided to triple the amount of requested wind energy capacity.

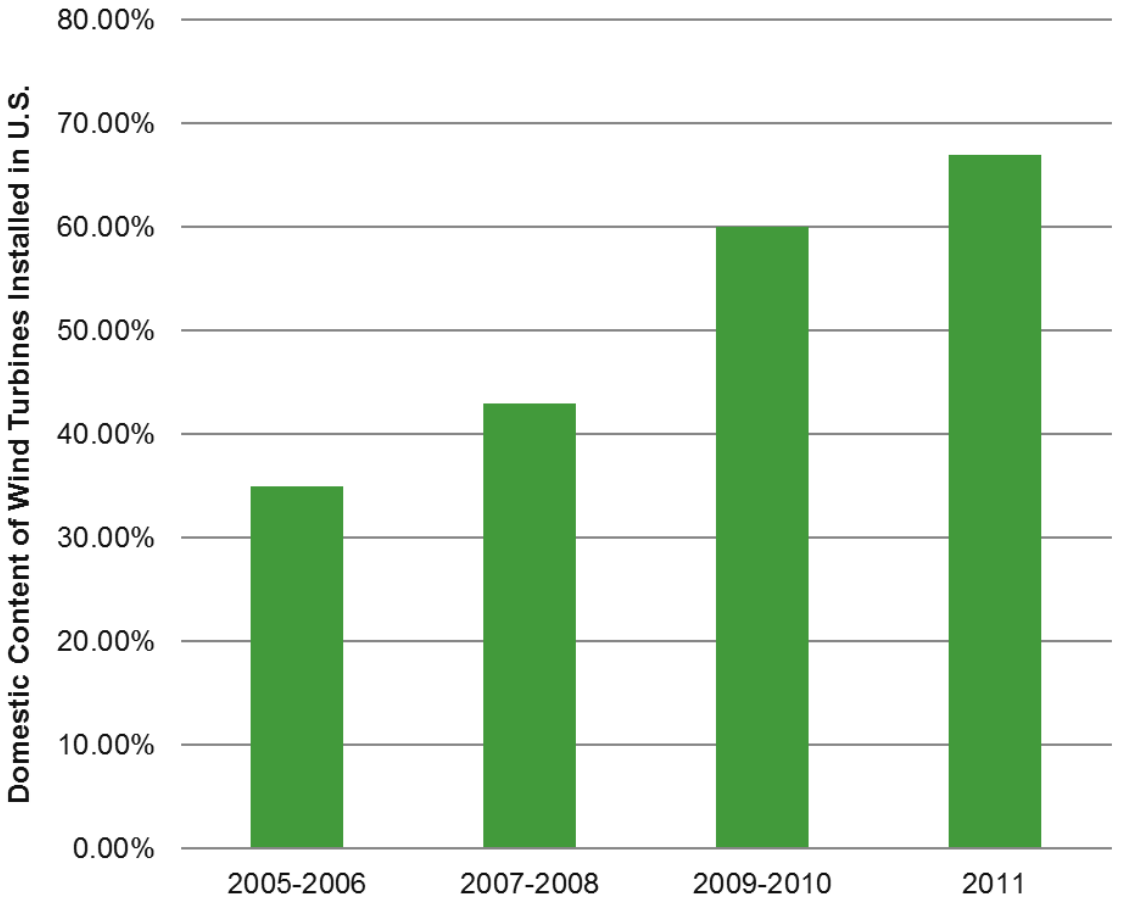
Source: AWEA U.S. Wind Industry Third Quarter 2013 Market Report

Consumers Price Benefits

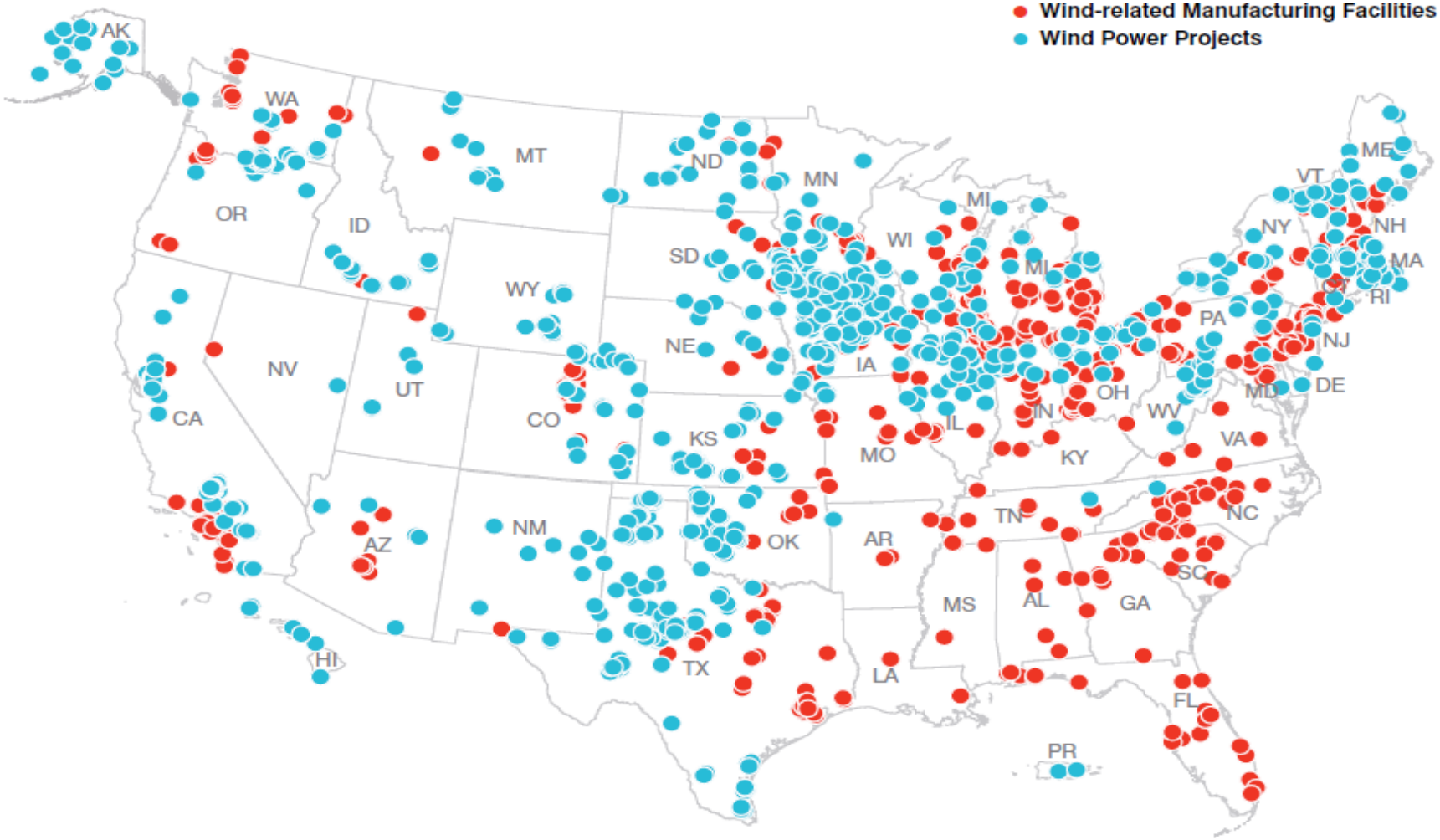
- Flat Ridge 2 wind power could lower SWEPCO customer bills in 2013 by roughly $.05 per monthly bill for customers using 1,000 kilowatt hours and $.11 per monthly bill in 2014." – SWEPCO
- Alabama Power, a subsidiary of Southern Company, is "absolutely looking for more wind power" to import from Midwestern states. Noting that Alabama does not have good wind resource. "**Wind energy is cost-effective for the utility's customers and helps diversify its fuel mix."** - Michael Sznajderman of Alabama Power.
- *"Wind generation provides value simply for the insurance it furnishes in insulating customers from some of the aspects of unexpectedly high and volatile fuel and wholesale energy prices" - Westar President & CEO William B. Moore, in direct testimony to the KCC on why Westar wished to add approximately 300 MW of wind power to its portfolio, Oct. 2007, 18 months*

Domestic Content of U.S. Installed Turbines

- ✓ Prior to 2005, wind turbines installed in U.S. had **25% of their components made in the U.S.**
- ✓ Today, U.S. manufacturing expanded rapidly so that now over **67% of the components installed in wind turbines are made in the U.S.**

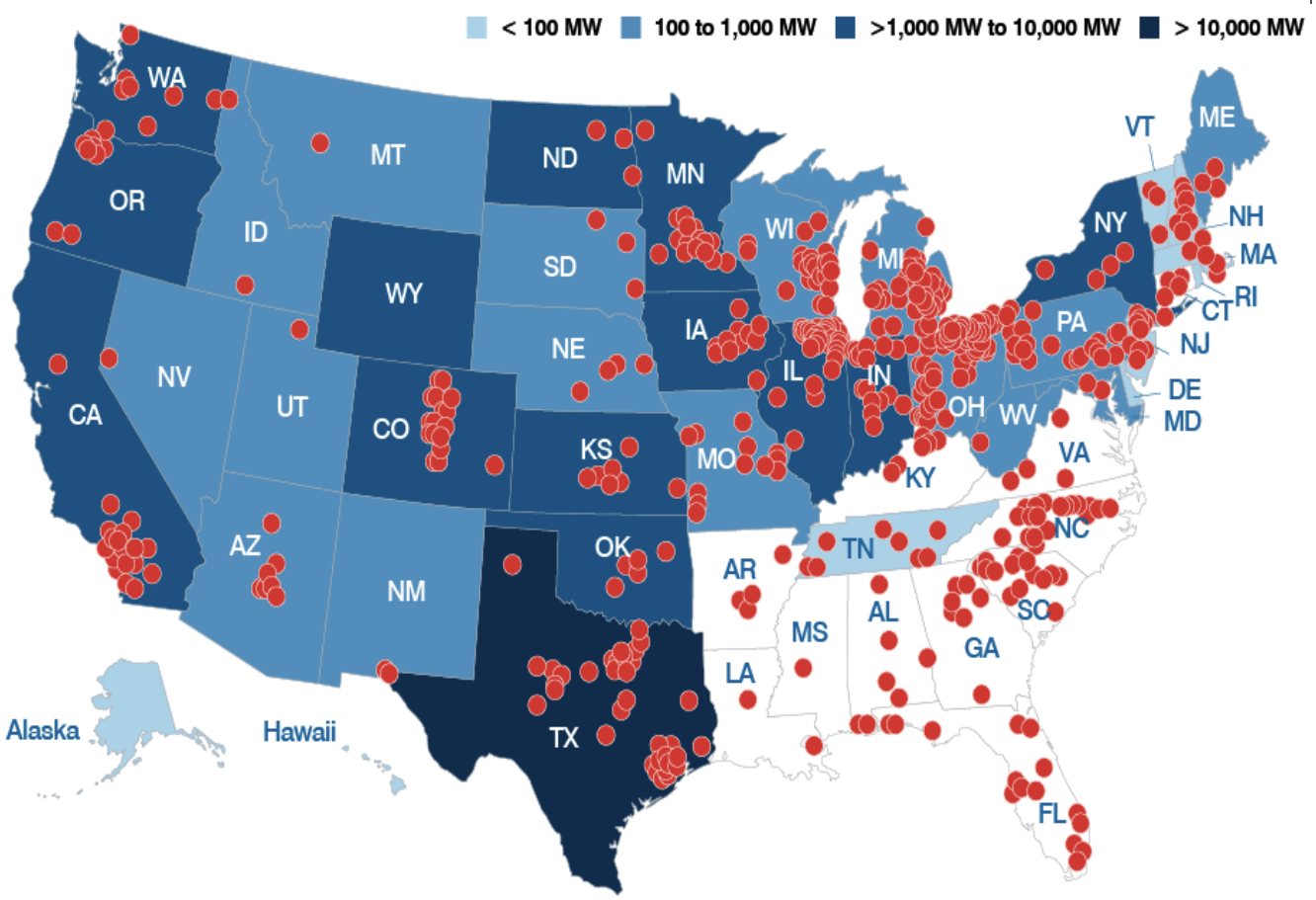


Wind-Related Manufacturing and Projects, by State

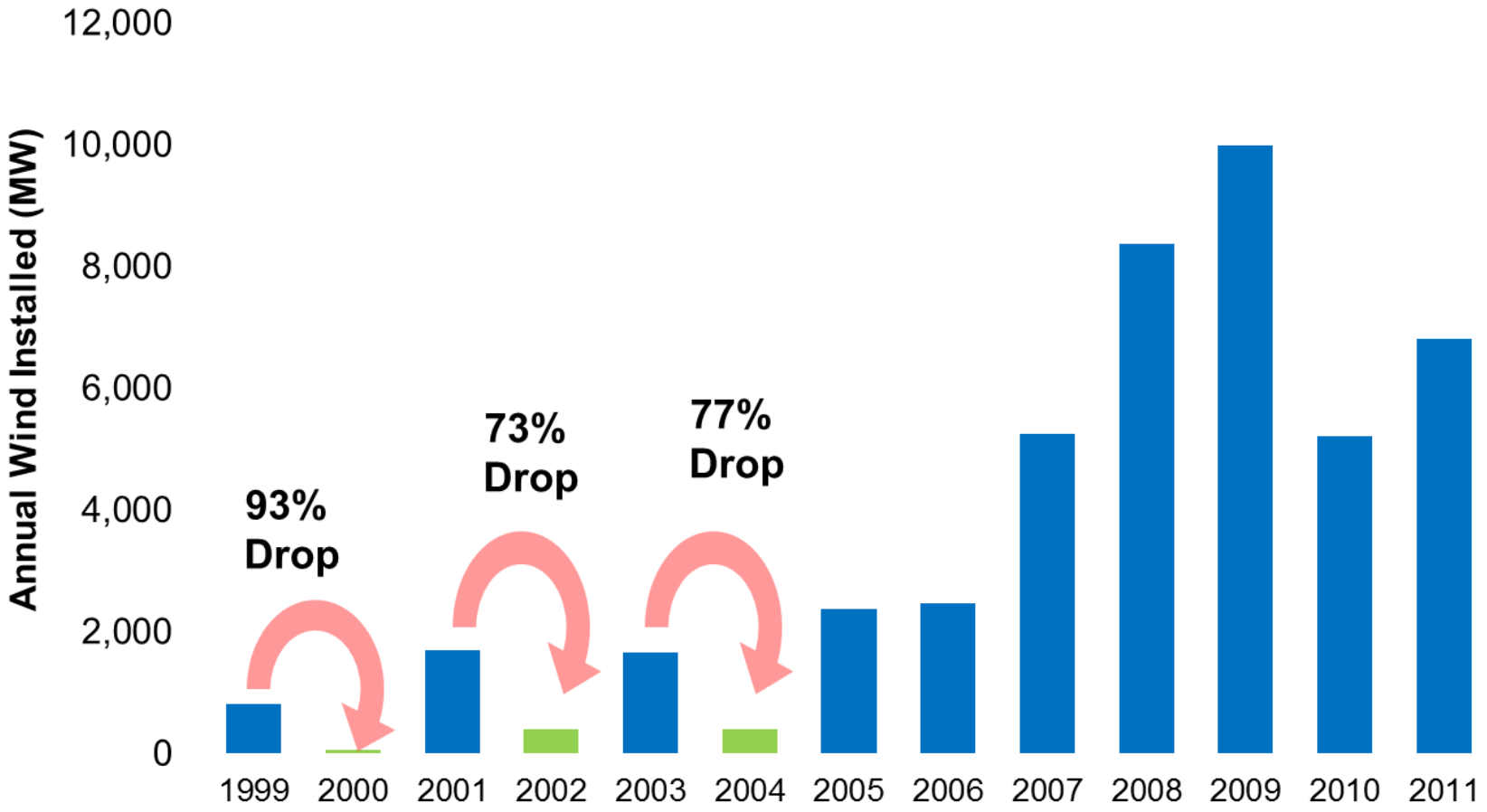


With 500 facilities, wind is one of the fastest-growing sources of U.S. manufacturing jobs

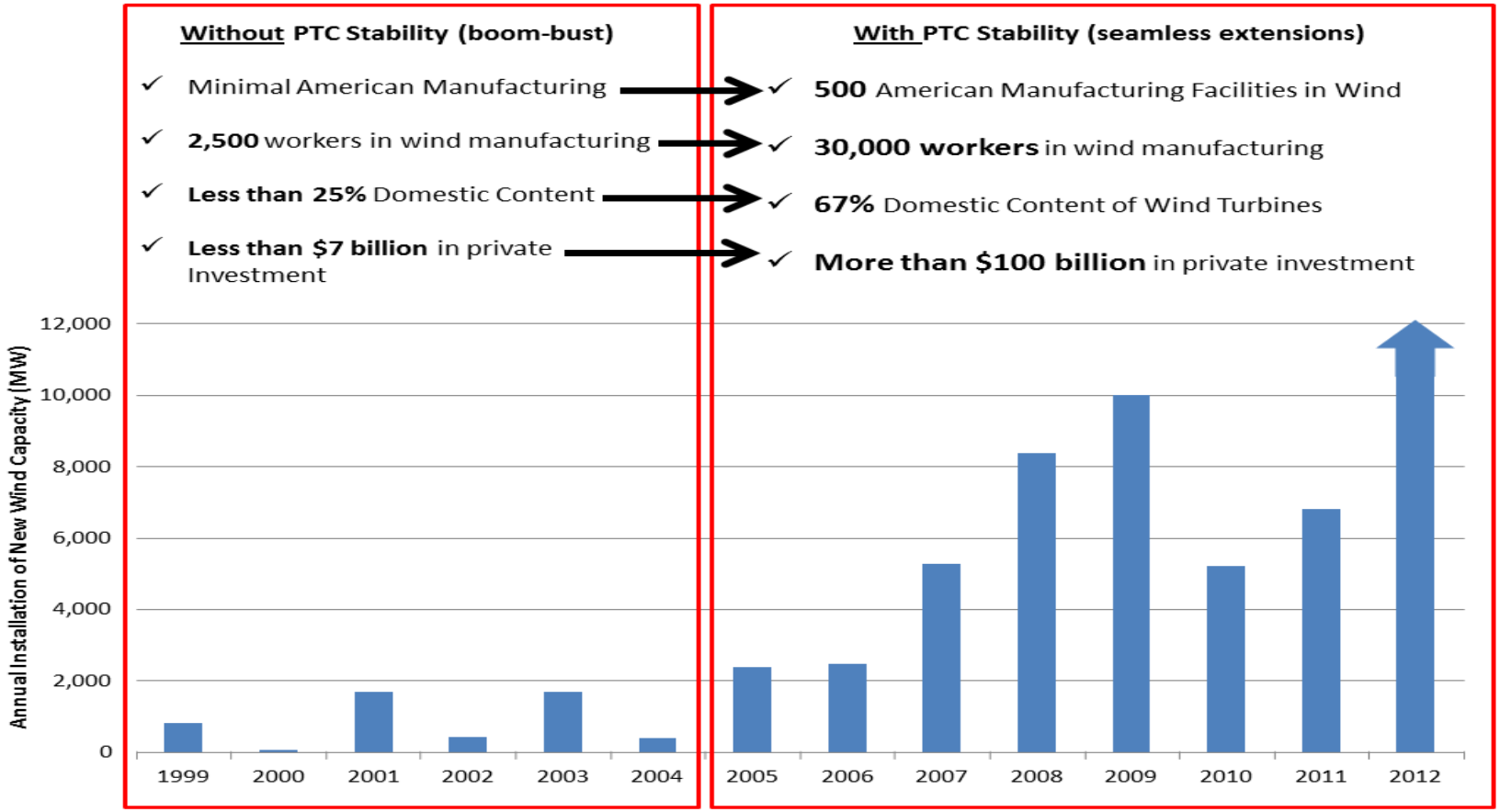
- At the end of 2012, there were **559** manufacturing facilities online making wind-related products.
- These online facilities span **43** states



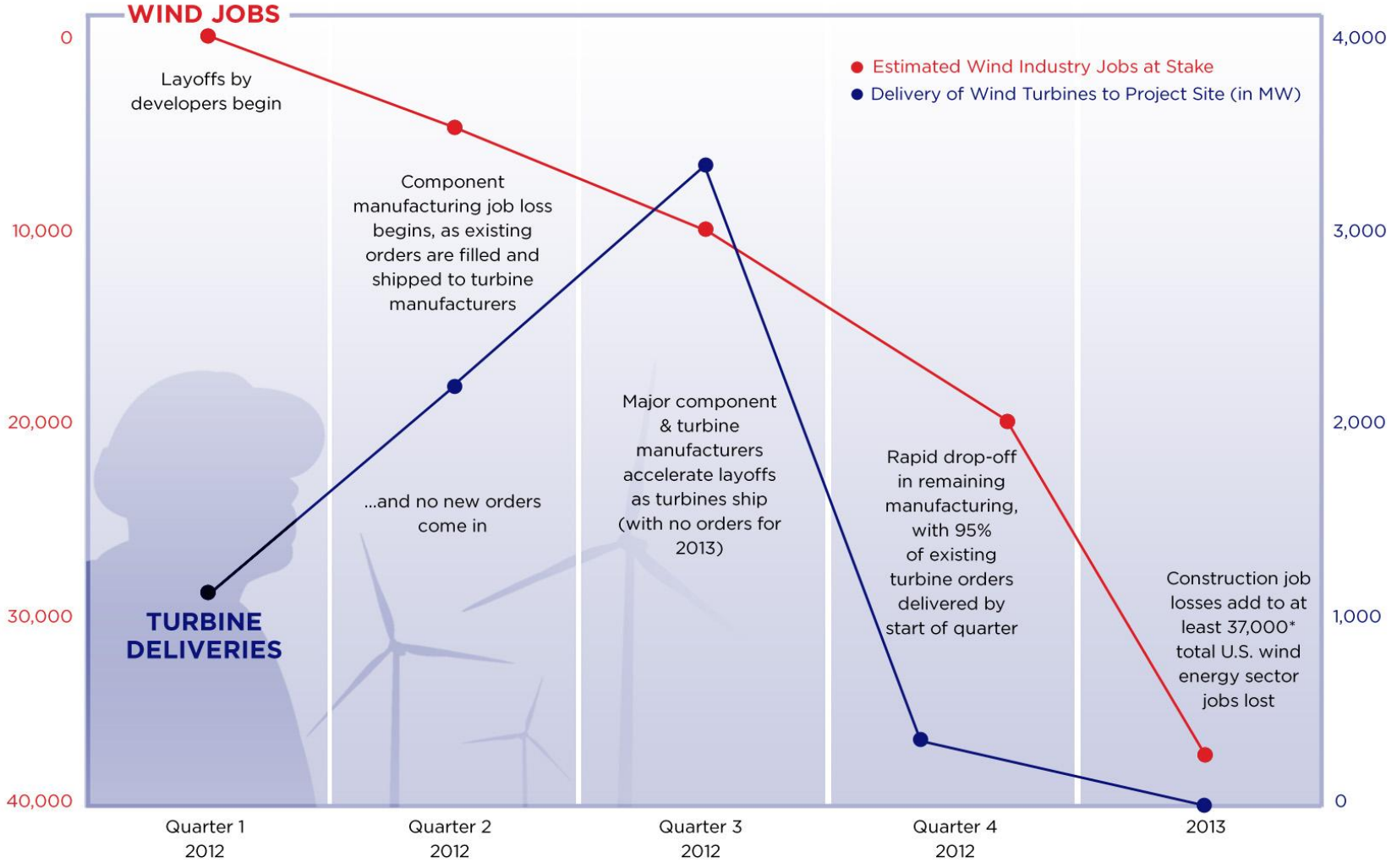
Key Drivers: Production Tax Credit (PTC)



Impact of Policy Certainty & Stability



PROJECTED JOB LOSSES IN U.S. WIND ENERGY AS PTC EXPIRES

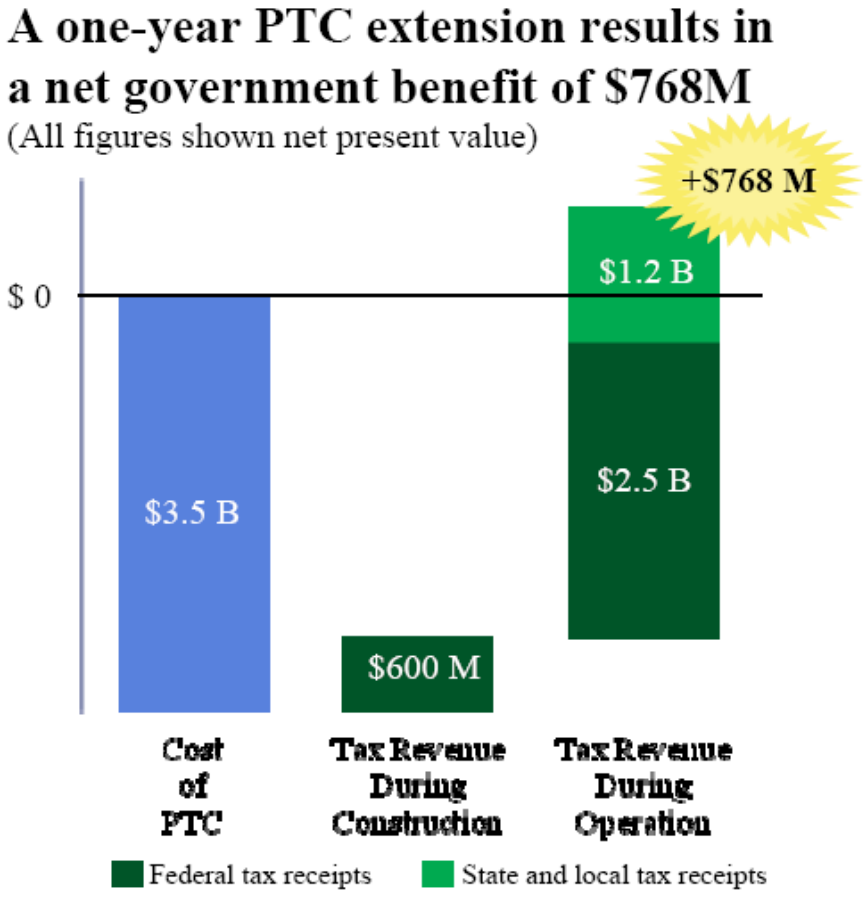


*Source for 37,000 Job Loss: Navigant Consulting

PTC Provides a Fiscal Net Benefit to the Government

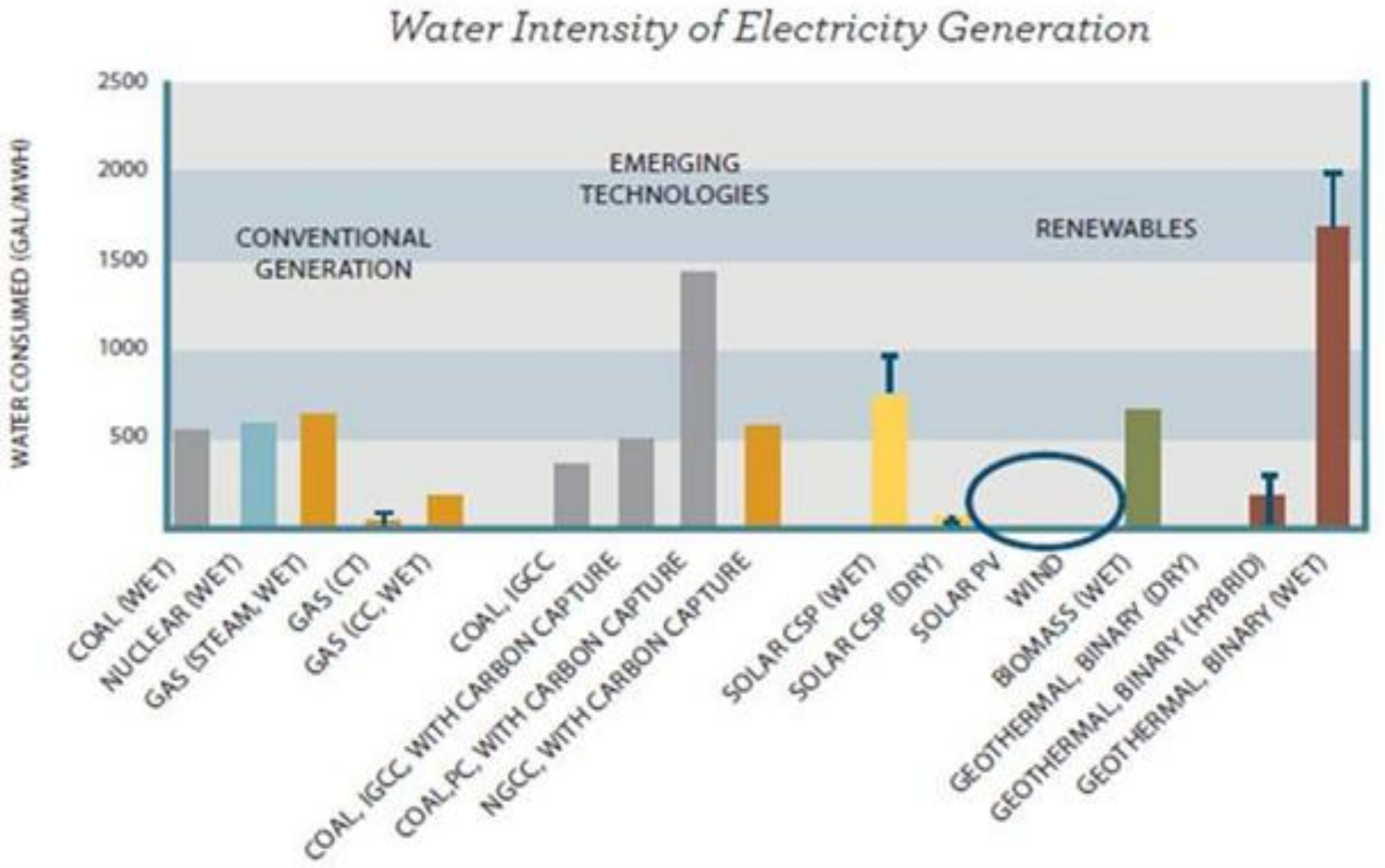
- **Federal impact:** Tax revenues flow from wind development projects for the life of the wind farm, well beyond the 10 years that the PTC is awarded. Income taxes on corporate profits and worker payroll also help offset the cost of the PTC to the U.S. Treasury.

- **State and local impact:** Wind projects deliver significant tax revenues to state and local governments through state income tax on wages and profits, property taxes and sales taxes.



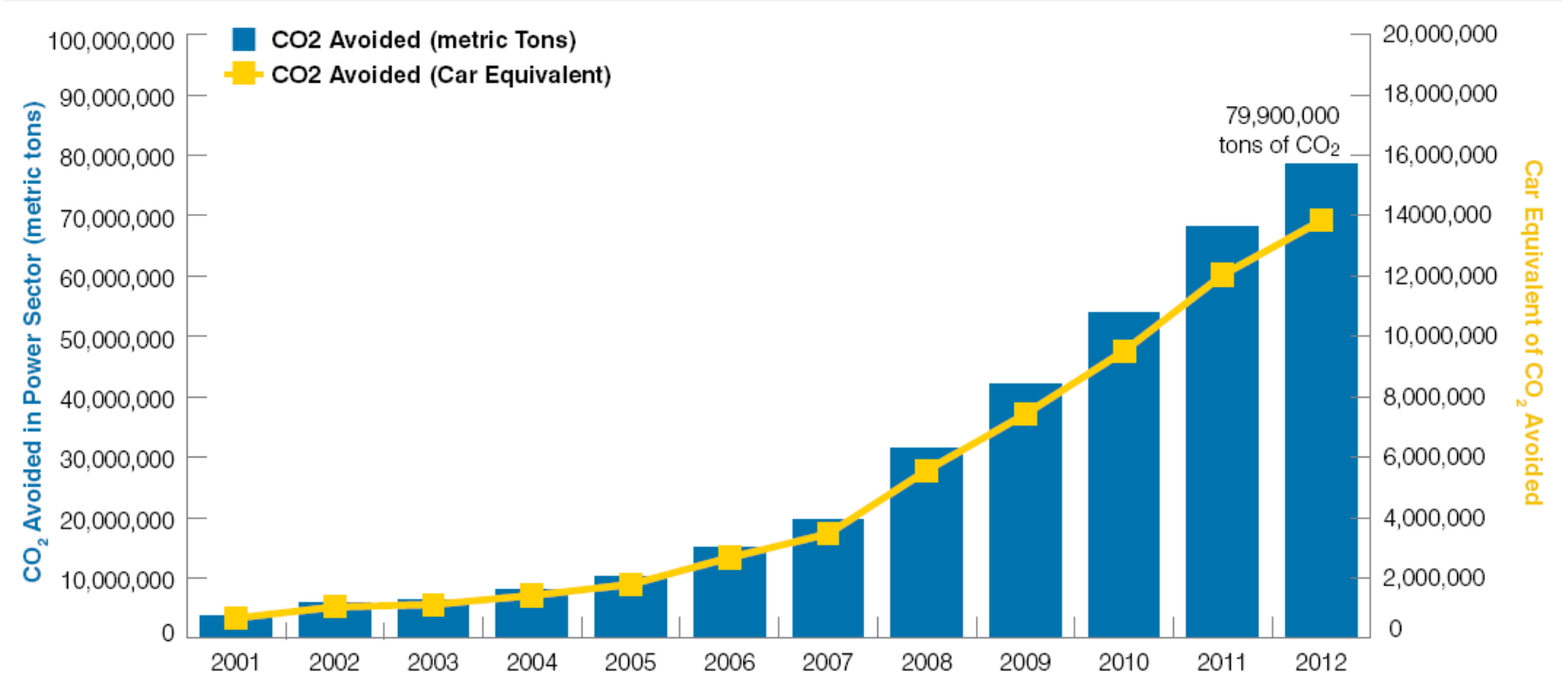
http://nexteraenergyresources.com/pdf_redesign/wind_ptc.pdf

Water Use by Technology

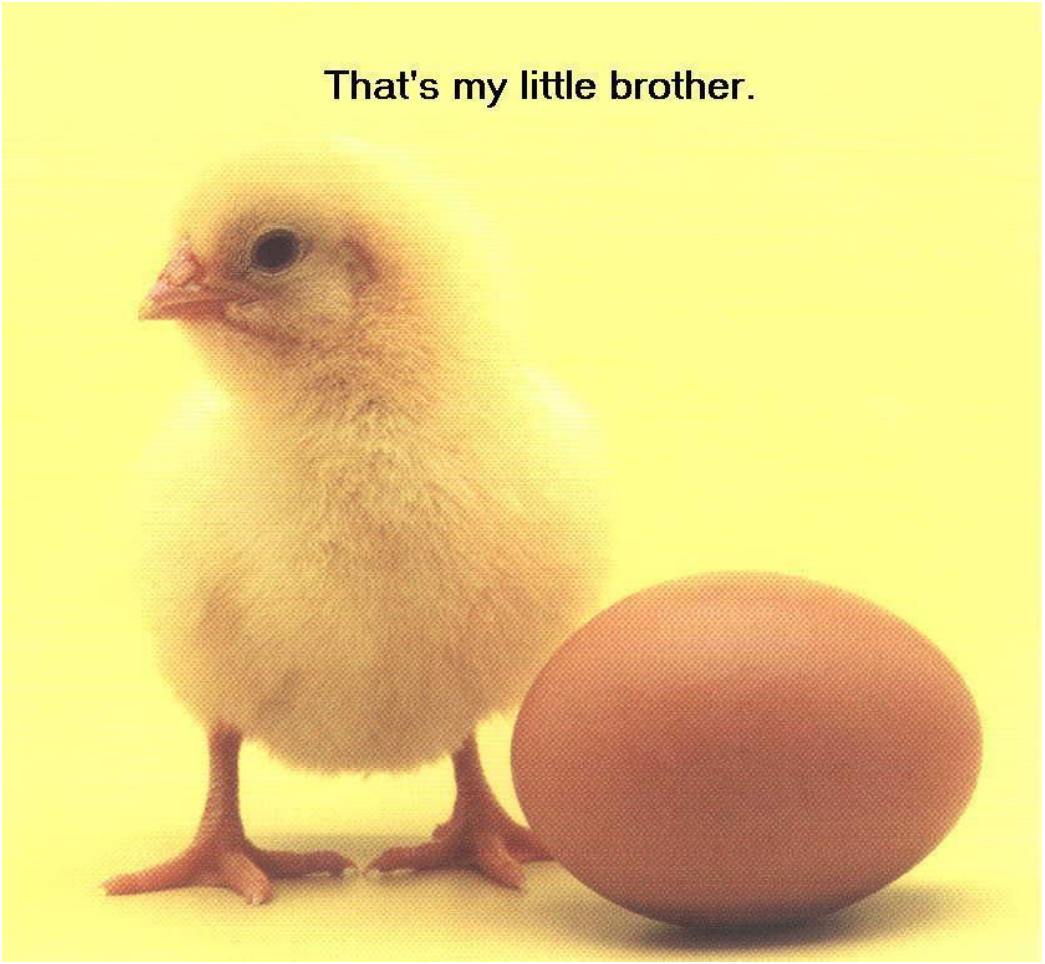


CO2 Emissions Reduction

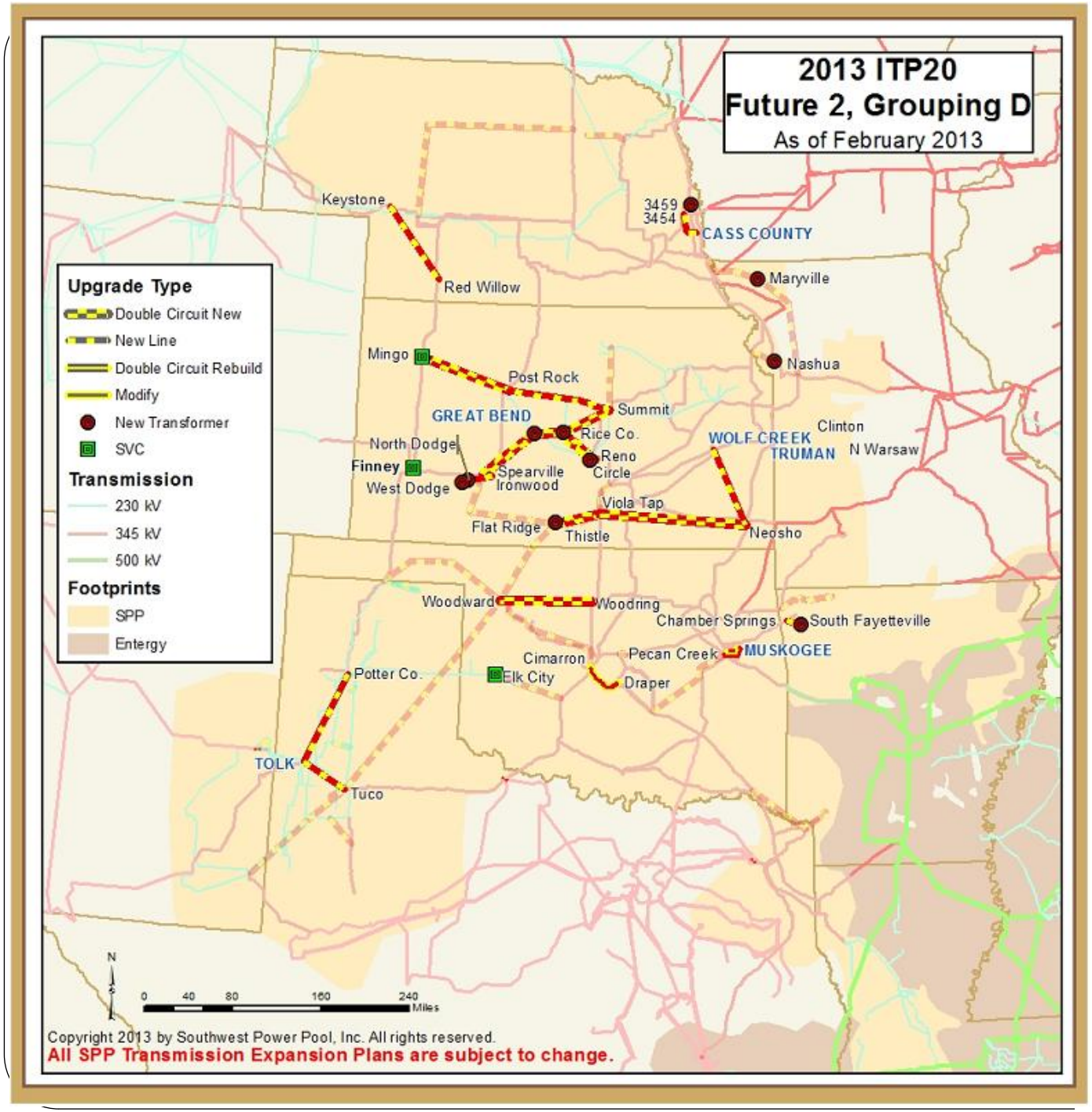
- **In 2012, the roughly 140 million megawatt-hours (MWh) generated by wind energy avoided 79.9 million metric tons of carbon dioxide (CO2)—the equivalent of reducing power-sector CO2 emissions by 3.6%,**
- **When the new wind projects installed throughout 2012 produce power for a full year, the entire U.S. wind fleet will avoid nearly 98.9 million metric tons of CO2, the equivalent of reducing power sector emissions by 4.4%.**



Which comes first: Renewable Generation or transmission to deliver it?



Road Block to potential development



Future 2

Total Cost: $2.47B

Reliability Cost: $775M

Policy Cost: $1.7B

Economic Cost: $0

Total Mileage: 1,973

Reliability Miles: 648

Policy Miles: 1,325

Economic Miles: 0

Total Transformers: 10

Future 3 C

Total Cost: $9.1B

Reliability Cost: $1.1B

Policy Cost: $8.0B

Economic Cost: $0

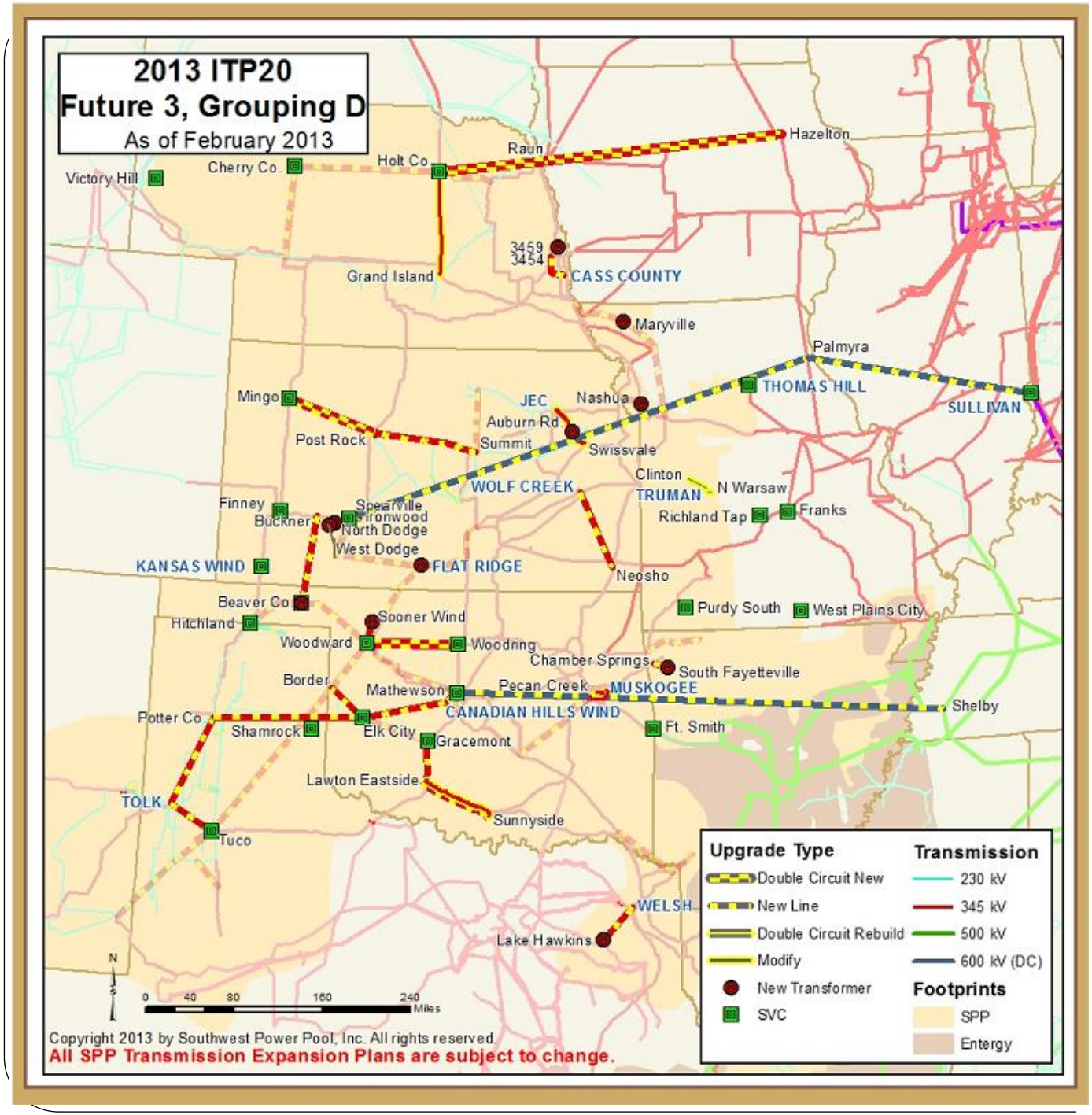
Total Mileage: 6,862

Reliability Miles: 858

Policy Miles: 6,004

Economic Miles: 0

Total Transformers: 22



Future 3 D

Total Cost: $7.23B

Reliability Cost: $986M

Policy Cost: $2.2B

HVDC Cost: $4.05B

Economic Cost: $0

Total Mileage: 5,297

Reliability Miles: 762

Policy Miles: 1,865

HVDC Miles: 1,275

Economic Miles: 0

Total Transformers: 10


Thank You!